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NEW NUCLEAR DATA

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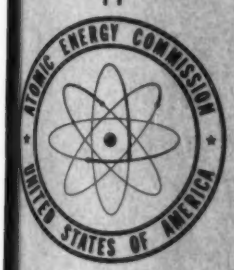

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NEW NUCLEAR DATA

Compiled by the Nuclear Data Group, National Research Council
Washington 25, D. C.

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Table 1. Radioactivity, Levels, Abundances, Moments
Table 2. Neutron Cross Sections
Table 3. Ground State Q's
Table 4. Mass Differences and Ratios

INTRODUCTION

This issue of Nuclear Science Abstracts, Volume 10, No. 18B, contains the 1956 third quarter list of new nuclear data. The data summarized here have come to hand since the preparation of the 1956 semi-annual cumulation which was published in Volume 10, No. 12B. The 1956 annual cumulation will appear early in 1957 in Volume 10, No. 24B. The 1952, 1953, 1954, and 1955 annual cumulations are contained in Vol. 6, No. 24B; Vol. 7, No. 24B; Vol. 8, No. 24B; and Vol. 9, No. 24B, respectively. Extra copies for 1952, 1953, and 1954 are exhausted; for 1955 they are obtainable for $0.60 from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Remittance should be by check or money order. Add 25% for foreign postage. Literature coverage is continuous; beginning in each new list where it ended in the last.

Nuclear Data Cards: As the current literature is surveyed, the new nuclear results are first printed on 3- by 5-inch cards which are collected into sets of about 150 cards each month. Individuals, laboratories, or libraries may subscribe to the card sets directly by applying to the Publications Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

Nuclear Level Schemes: The first section of a new comprehensive nuclear data table prepared by the Nuclear Data Group was published last fall by the Government Printing Office. The aim of Nuclear Level Schemes is to provide a revision and expansion of Nuclear Data which was issued in 1950 as Circular 499 of the U. S. National Bureau of Standards. It will be published in five or six sections, each one of which will be issued upon completion. The first section, now available, gives the data for known nuclei with mass numbers between A = 40 and A = 92, thus covering roughly the elements $_{20}$Ca through $_{40}$Zr. The second section will summarize the information for the next 20 elements, the third for 20 more, and so on.

The style of presenting data in Nuclear Level Schemes is very similar to that used on the Nuclear Data Cards and in the cumulated lists of Nuclear Science Abstracts. The cards, or the lists, will thus provide a convenient means of keeping this table up to date.

Nuclear Level Schemes (A = 40 to A = 92), TID-5300, can be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.75, 240 pages paperbound. Remittance should be by check or money order. Add 25% for foreign postage.

CONVENTIONS

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

Numerals in italics, following measured values, are the errors (as reported by the authors) in the last figure of the values. In cases where confusion seems possible, the conventional ± is used.

Magnetic moments are reported as before without diamagnetic correction. They are based on $\mu(H) = 2.79267$ and the substandards listed by H. Walchli, ORNL-1469.

In writing reactions, the upper right hand superscript denoting A, the mass number of the target nucleus, is given without parentheses when the target was monoisotopic or when enriched (or depleted) material was used to establish the identity of the reacting isotope. It is given in parentheses when natural material was used and when the identity of the reacting isotope was strongly suggested by its predominating abundance, the observed reaction energy, or the activity or yield of the end product. It is given in parentheses with a question mark when the target A was assigned by systematics, elimination, etc. For instance, "B^{10}(d,p)" means that the proton groups from the deuteron bombardment of B^{10} were identified by comparing effects in B^{10} enriched and natural B samples. "B^{11}(d,p)" means that the assignment to B^{11} was made by using B^{11} depleted and natural B samples. "$C^{(12)}$(d,p)" means that natural C was used to study the reaction, but, because of the 99% abundance of C^{12}, the reaction observed was assumed to take place in that isotope. In the reaction "$Sn^{(116)}$(n,p)13^{s}In," the Sn isotope was identified by the In product. "$Te^{(125?)}$(d,p)$Te^{(126?)}$" indicates that from the trend of Q values in the region, the experimenters believed that their measured Q most likely belonged to the indicated reaction.

When a method of production of a radioactive nucleus is given, the lowest bombarding energy used by the experimenter is indicated; e.g., Ag(20-Mev p,n).

The large black dots on the decay schemes are used to indicate experimentally established coincidences. α, β, or γ rays entering a level and dotted at their arrowheads have been shown to be in coincidence with gamma rays leaving the same level and dotted at their origins. In case of a simple cascade, the dots of the incoming and outgoing rays are superimposed. Dashes are used for doubtful radiations or levels.

For the light nuclei, energy levels in the compound nucleus are usually tabulated rather than the resonant energy of the bombarding particle. The binding energy of the bombarding particle in the compound nucleus is taken from the table of F. Ajzenberg, T. Lauritsen, Revs. Modern Phys. 27, 77(1955) for Z < 11 and from P. M. Endt, J. C. Kluyver, Revs. Modern Phys. 26, 95(1954) for Z from 11 to 20.

ABBREVIATIONS

a	absorption
a $\beta\gamma$	absorption of β's in coincidence with γ's
a ce	absorption of conversion electrons
a coin	absorption of photoelectrons between counters in coincidence
act	neutron detection by activation (Mn, Rh, Ag, ...)
α	total γ-ray conversion coefficient, N_e/N_γ
$\alpha_K, \alpha_L, \ldots$	γ-ray conversion coefficient for electrons ejected from the K, L, ... shell
$\alpha_0, \alpha_1, \ldots$	α to g.s., first excited state, ... of residual nucleus
B	band spectra method
B(E2)	reduced E2 excitation probability in barns^2 (upward transition)
Be(γ,n)	measurement by detection of photoneutrons from Be
BF_3	boron trifluoride neutron counter
B_n, B_p	neutron, proton binding energy, i.e., energy necessary to remove particle from nucleus
$\beta\gamma$ ($t_\perp$)	polarization-direction correlation of β's and γ's in coincidence
$\beta\gamma(\theta)$	angular correlation of β's and γ's in coincidence
calc	calculated from experimental work reported elsewhere
cc	cloud chamber
CcW	Cockcroft Walton accelerator
ce	conversion electrons
chem	chemical separation of product following reaction
Cp	Compton
crit a	critical absorption
cryst	crystal spectrometer
cyc	cyclotron
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript
D	double resonance method
d,p(θ)	angular distribution of protons with respect to deuteron beam
D(γ,n), D(γ,p)	measurement by detection of photoneutrons or photoprotons from deuterium
$\bar{E}$	average energy
E_0	resonance energy
$E_\beta, E_\gamma, \ldots$	energy of β ray, energy of γ ray, ...
E_{dis}	disintegration energy
EA	electrostatic analyzer
E1, E2, ...	electric dipole, electric quadrupole, ...
E_ϵ	energy of the electron capture transition (end point of γ continuum + K binding energy)
e_A	Auger electron
e_{AK}, e_{AL}	KXY, LXY Auger electron
el	elastic scattering
ϵ	electron capture
ϵB(E2)	partial B(E2) for radiation studied (photon, ce_K, or ce_L)
ϵ_K, ϵ_L	electron capture from K, L shell
$\eta(\theta)$	$[W(\theta) - W(\pi/2)]/W(\pi/2)$, a measure of asymmetry in angular distributions, where $W(\theta)$ is the count at angle θ
f	fission
F-K	Fermi-Kurie plot
ft	comparative half-life in the Fermi theory of β decay calculated for an allowed transition. Superscript 1, 2, or 3 on *f* indicates that comparative half-life is calculated for a unique 1st, 2nd, or 3rd forbidden transition.
g	(1) gyromagnetic ratio (2) statistical weight factor, $\frac{1}{2}[1 \pm 1/(2J+1)]$, in g Γ_n
Γ	resonance half-width (the whole width at half-maximum)
Γ_γ, Γ_n	partial resonance half-width for γ, neutron emission
$\gamma^\pm$	annihilation radiation
γ continuum	continuous γ spectrum associated with electron capture
$\gamma(Hg^{198})$	γ is emitted from nucleus in parentheses rather than from radioactive parent
$\gamma(\theta, T)$	γ intensity as function of angle and temperature
$\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, nγ	$\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, or nγ concidences. (0.123 γ) (0.246 γ, 0.325 γ) means 0.123 γ in coincidence with 0.246 γ and 0.325 γ
$\gamma\gamma(\theta)$	angular correlation of γ's in coincidence
$\gamma\gamma(t_\perp)$	polarization-direction correlation of γ's in coincidence

GM	Geiger-Müller counter
g.s.	ground state
h	hours
I	nuclear induction method
IB	internal bremsstrahlung
ic	ionization chamber
IT	isomeric transition
J	spin in units $h/2\pi$
K/L, K/LM	α_K/α_L, $\alpha_K/(\alpha_L + \alpha_M)$
L_1L_2/L_3	$(\alpha_{L_1} + \alpha_{L_2})/\alpha_{L_3}$
l	orbital angular momentum
Lin	linear accelerator
m	(1) medium intensity, (2) minutes, when used as a superscript
M	molecular or atomic beam resonance method
M1,M2, ...	magnetic dipole, magnetic quadrupole, ...
mb	millibarns
Mev	million electron volts (10^6 ev)
mev	millielectron volts (10^{-3} ev)
Mic	microwave method
mir	measurement by total reflection of neutron beam from mirror surface
mod cyc	modulated cyclotron
ms	(1) milliseconds, 10^{-3}s (2) mass spectrometer
mμs	millimicroseconds, 10^{-9}s
μ	nuclear magnetic moment (nuclear magnetons)
μ_3	nuclear magnetic octopole moment (nuclear magneton barns)
μs	microseconds, 10^{-6}s
μμs	micromicroseconds, 10^{-12}s
n res	known resonance of a "standard" element used to identify an unknown neutron energy
ν	neutrino
osc	pile oscillator method
θ^2	reduced level width in units of $3\hbar^2/2MR$
p	(1) proton, (2) predecessor of
para	paramagnetic resonance method
parentheses	parentheses are put around values which are given for identification purposes
pc	proportional counter
pe	photoelectrons
ppl	photoplates or emulsions
pr	electron-positron pair
p res	proton resonance. Magnetic field standardized by means of proton resonance frequency
primes	primes indicate inelastically scattered particles
q	electric quadrupole moment in units of barns
quad res	quadrupole resonance method
q_4	nuclear electric 16-pole moment in units of 10^{-48} cm^4
Q	reaction energy in Mev
R	nuclear radius in fermis (10^{-13} cms)
s	(1) spectrometer method, (2) seconds, when used as superscript
s coh	coherent scattering
S	atomic spectra measurement
scin	1-crystal scintillation counter
scin Cp	2-crystal scintillation counter
scin pr	3-crystal scintillation counter
sd	double focusing spectrometer
sl	lens spectrometer
sl ce	conversion electrons measured in lens spectrometer
st	strong
sπ	180° spectrometer
sπ pr	180° pair spectrometer
σ	cross section in barns
σ_o	cross section at resonance energy, E_o
σ_a	absorption cross section
σ_t	total cross section
Σpc	proportional counter used to sum energy of transitions in cascade
Σscin	scintillation counter used to sum energy of transitions in cascade
t	(1) triton, H^3, (2) total cross section when used under σ in cross section list
T	(1) isotopic spin, (2) temperature
τ	half life in units indicated
τ_1, τ_2	half life of upper, lower state
$\tau_{\beta\beta}, \tau_{\epsilon\epsilon}$	half life for double β, double ϵ decay
th	thermal
trans	transmission
VdG	Van de Graaff accelerator
w,vw	weak, very weak
ω_K, ω_L	K,L fluorescence yield
x	x radiation
y	years
$Y_\gamma, Y_p, \ldots$	yield of γ rays, yield of protons, ...
%	number per 100 disintegrations. For γ's, total number of photons plus ce's is meant
†	number relative to other numbers marked †. For γ's, number of photons only is meant
+,−	even, odd parity when used in connection with level properties

Standard journal abbreviations are used.

TABLE 1—RADIOACTIVITY, LEVELS, ABUNDANCES, MOMENTS,

ν $\sigma[Cl^{37}(\nu,e^-)A^{37}] < 0.9\times10^{-21}$b for fission ν

R.Davis,Jr., Bull. Am. Phys. Soc. 1, No. 4, 219 UA5 (1956).

$He^4_{2\ 2}$ $He^{(4)}(p,p')$ $E_p = 40$
No level found between 23 and 28 Mev scin
$\sigma(65°) \leq 0.25$ mb/sterad if $\Gamma < 0.5$

R.M.Eisberg, Phys. Rev. 102, 1104 (1956); Bull. Am. Phys. Soc. 1, No. 1, 19 DA1 (1956).

$He^5_{2\ 3}$ Polarization $H^2(d,n)$; $He^{(4)}(n,n)$
Azimuthal asymmetry of n's scattered from He studied. Results consistent with polarization calc. with Seagrave[1] not Huber[2] phases

I.I.Levintov, A.V.Miller, V.N.Shamshev, Doklady Akad. Nauk SSSR 103, 803 (1955).
[1]Phys. Rev. 92, 1222 (1953).
[2]Helv. Phys. Acta 25, 437 (1952).

Li$_3$ Relative isotopic abundances ms
Li^6 8.12% $Li^7/Li^6 = 11.32$
Li^7 91.88% No error given
No Li^5 ($< 7\times10^{-5}$%) No Li^8 ($< 1\times10^{-4}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

$Be^7_{4\ 3}$ τ 53.0^d 4 $C^{(12)}$(160-Mev p) chem
$[\lambda(Be) - \lambda(BeF_2)]/\lambda = 0.0012$ 1 differential ic
^{54}d

R.Bouchez, J.Tobailem, J.Robert, R.Muxart, R.Mellet, P.Daudel, R.Daudel, J. phys. radium 17, 363 (1956).

$Be^8_{4\ 4}$ Levels $Li^7(d,n)$ $E_d = 0.92$ ppl
Energy distribution of 1200 tracks shows maxima corresponding to Be^8 levels at g.s., 3.0, 4.1, 4.8, 5.8, 7.5, 9.6
n group to g.s. has experimental width of 0.43

J.R.Bird, R.H.Spear, Australian J. Phys. 8, 567 (1955).

γ $Li^{(7)}(p,\gamma)$ $E_p = 0.20$ to 0.44
17.6γ/14.8γ increases with E_p by factor of 3.4 in above E_p range scin

J.G.Campbell, Australian J. Phys. 9, 156 (1956).

$Be^9_{4\ 5}$

	ground state	
J	3/2	I
$\lvert\mu\rvert$	1.1774 2	

L.C.Brown, D.Williams, J.Chem. Phys. 24, 751 (1956).

$Be^{10}_{4\ 6}$ Level $Be^9(n,n)$ $E_n = 0.53$ to 0.9
$\Gamma = 0.008$ (7.37) $J = 2^+$ or 3^+ $\sigma(E,\theta)$

R.O.Lane, J.E.Monahan, Bull. Am. Phys. Soc. 1, No. 4, 187 K1 (1956); verbal report.

$B^9_{5\ 4}$ Level $B^{(10)}(d,t)$ $E_d = 7$
g.s. $Q = -2.187$ 10 s

C.K.Bockelman, A.Lévêque, W.W.Buechner, Bull. Am. Phys. Soc. 1, No. 6, 280 B1 (1956).

$B^{11}_{5\ 6}$ Levels* $Be^9(d,d)$ $E_d = 1.02$ to 1.44
16.769 $\Gamma \sim 0.07$ 90° to 160°
17.021 $\Gamma \sim 0.12$ ppl
*Increases in σ_{el}/σ(Rutherford) found

M.K.Jurić, S.D.Cirilov, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 45 (1956).

$B^{13}_{5\ 8}$ Level $Li^7(Li^7,p)$ $E_{Li^7} = 1.61$
g.s. $Q = 5.97$ 3 scin 90°

S.K.Allison, P.G.Murphy, E.Norbeck,Jr., Phys. Rev. 102, 1182 (1956).

$C^{12}_{6\ 6}$ Levels $B^{10}(He^3,p)$ $E_{He^3} = 1.25$
400† (4.43) scin
10† (7.6)
No level between 4.43 and 7.6 (< 1†)

C.D.Moak, A.Galonsky, Bull. Am. Phys. Soc. 1, No. 4, 196 N8 (1956); verbal report.

Levels $B^{11}(p,\gamma)$ $E_p = 0.63, 1.39$
(16.57) 12.14γ is E1 scin,
(17.22) 17.22γ is E1 $e^+,e^-(\theta)$

S.Gorodetsky, R.Armbruster, P.Chevallier, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22, (1956).

$C^{13}_{6\ 7}$

Level $C^{(12)}(d,p)$ $E_d = 0.60$ to 1.45
g.s. ppl
Values given of $a_0 \cdots a_5$ in $\Sigma a_i P_i(\theta)$ for d,p(θ)

M.K.Jurić, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 35 (1956).

Level $C^{(12)}(n)$ $E_n = 0.66$ to 2.15
(6.87) $\Gamma = 0.011$ $J = 3/2$ σ_t
n,n(θ) shows d-wave involved

J.E.Wills,Jr., Bull. Am. Phys. Soc. 1, No. 4, 175 F3 (1956).

Levels $C^{(12)}(n)$ $E_n = 4.4$ to 5.5,
9.33 7.6 to 8.6
9.52 $J > 1/2$? σ_t

R.L.Becker, H.H.Barschall, Phys. Rev. 102, 1384 (1956); 99, 1646A (1955).

Levels $Be^9(\alpha,n\gamma)$ $E_\alpha = 1.5$ to 5.3 BF_3, scin γ

σ_n^*	$\sigma_{4.4\gamma}^{**}$	Level[$]	Γ
25	14	12.0	0.2
15		12.2	~0.2
20	4.7	12.5	~0.2
79	20	13.41	0.06
60	18	13.7	~0.4
87	23	14.1	~0.3

*mb/sterad, 0° to 20° **mb/sterad, 0° to 10°
[$]Not corrected for Coulomb barrier penetration

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

$N^{14}_{7\ 7}$

Levels $N^{(14)}(\alpha,\alpha')$ $E_\alpha = 21.5$
3.95 4 $s\pi$ several angles
5.12 7
5.79 7 7.94 7
6.47 9 8.45 7
7.01 6 10.05 7
2.31, 7.40, 7.72, 8.06, 9.49 levels not observed

D.W.Miller, B.M.Carmichael, U.C.Gupta, V.K. Rasmussen, M.B.Sampson, Phys. Rev. 101, 740 (1956).

Levels $C^{(12)}(d,p)$ VdG, scin

E_d	Level	E_d	Level
2.465	12.38	4.004	13.70
2.669	12.55		Γ = 150 kev
2.992	12.83	5.336	14.84
3.388	13.17	5.635	15.09

d,$p_0(\theta)$ for $E_d \simeq 3.0, 4.0, 4.75$ shows $l = 1$ pattern
d,$p_1(\theta)$ for $E_d \simeq 4.75$ shows $l = 0$ pattern

$C^{(12)}(d,n)$ long counter

3.01	12.84 3	3.95	13.65 3
3.36	13.14 3	4.61	14.21 3

d,$n_0(\theta)$, d,$n_1(\theta)$ shows $l = 1$, $l = 0$ resp. for $E_d \sim 4$

T.W.Bonner, J.T.Eisinger, A.A.Kraus,Jr., J.B.Marion, Phys. Rev. 101, 209 (1956).

$N^{14}_{7\ 7}$

$N^{(14)}(\gamma,p)$ $E_\gamma = 8.06$
Observed resonant absorption by broad level at ~8.06 of γ's from same level produced by $C^{13}(p,\gamma)$

G.M.Griffiths, Can. J. Phys. 34, 339 (1956).

Levels $B^{10}(\alpha,n)$ $E_\alpha = 2$ to 5.5
$B^{10}(\alpha,p\gamma)$ BF_3, scin γ

σ_n^*	$\sigma_{3.7\gamma}^{**}$	Level	Γ
0.9	12	13.16	0.03
0.6	12	13.23	0.20
1.1	8.0	13.68	0.20
	8.7	14.2	0.40
	13	14.43	0.2
	14	14.85	0.2
24	11	15.08	~0.05
21	13	15.44	0.1

*mb/sterad, 0° to 20° **mb/sterad, 40° to 50°

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

$N^{15}_{7\ 8}$

Levels $C^{14}(p,\gamma_0)$ $E_p = 0.2$ to 1.7
$C^{14}(p,n)$ $E_p = 0.9$ to 2.5

J	Level	Γ_n(kev)	Γ_p(kev)	Γ_{γ_0}(ev)
	10.544[1]			< 0.004
$3/2^-$	10.707			0.12
$3/2^-$	10.810			0.010
$1/2^-$	11.290	1.6	10.4	0.29
$1/2^+$	11.43	32.8	8.2	2.15
$1/2^+$	11.61[2]	5.0	470[3]	26.3
$3/2^+$	11.76	36.5	0.5	
$5/2^-$	11.88	24.5	0.03	
$1/2^-$	11.96	21.2	0.3	
$5/2^-$	12.09	17.2	0.8	
$3/2^+$	12.15	38.0	15.0	
$5/2^+$	12.33	21.7	0.3	

Authors suggest 10.458 or 10.06 level is responsible for $\sigma[N^{14}(\text{th n},\gamma)]$
[1]Strong 7.1 capture γ observed which is not seen in N^{14}(th n,γ) spectra
[2]Possibly $T = 3/2$ analog to C^{15} g.s.
[3]Accounts fully for $\sigma[N^{14}(\text{th n},p)]$
J values from p,$\gamma_0(\theta)$, p,n(θ), σ_{nn}^*, σ_{np}^*

G.A.Bartholomew, F.Brown, H.E.Gove, A.E. Litherland, E.B.Paul, Can. J. Phys. 33, 441 (1955); Phys. Rev. 95, 595, 649A (1954); 96, 823A, 1154 (1954); (2)Can. J.Phys. 34, 147 (1956); *Hinchey et. al., Phys. Rev. 86, 483 (1952).

Levels $B^{11}(\alpha,n)$ $E_\alpha = 1.9$ to 5.5

σ^*	Level	Γ(kev)	σ^*	Level	Γ(kev)
23	12.50	59			
11	12.90	90	16	13.72	40
>8.9	13.14	<3	11	13.87	70
17.7	13.17	~7	18	14.11	~10
13	13.36	25	14	14.18	35
14	13.59	20	24	14.66[$]	72

*mb/sterad, 0° to 20°
[$]Also observed in $B^{11}(\alpha,n+2.3\gamma)$

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

$N^{15}_{7\ 8}$ Levels $C^{13}(d,\alpha_o)$ $E_d = 1$ to 3; $C^{13}(d,t_o)$ sd

Γ(kev)	$C^{13}(d,\alpha_o)$	$C^{13}(d,t_o)$ sd
broad	17.10	
200		17.22 4
400	17.35 4	17.35 4
200		17.57 4
600	17.69 5	
55 10	17.71 1	17.71 1
22 4	18.06* 1	
50		18.02 2
27 7	18.36	

*$\sigma(E,\theta)$ shows $l_d = 3,4$; $\Gamma_d \sim 0.2$ kev
$d,\alpha_o(\theta)$, $d,t_o(\theta)$ show forward peaking for all E_d

J.B.Marion, G.Weber, Phys. Rev. 102, 1355 (1956)

$N^{16}_{7\ 9}$ $\gamma(O^{16})$ $F^{19}(n,\alpha)$; $O^{(16)}(n,p)$ scin pr

145†	(6.130)	
10†	7.116 20	

Both γ's decay with same τ ($7^s \pm 7\%$)
No evidence for an isomeric level of N^{16}

B.J.Toppel, Phys. Rev. 103, 141 (1956).

$\gamma(O^{16})$ N^{15}(3.3-Mev d,p)
6.13 and 7.12 γ's decay with same τ ($7^s \pm 10\%$)

$\gamma(N^{16})$ $N^{15}(d,p\gamma)$ $E_d = 3.3$

100†	0.1204 10	100†	0.276 2	pc,
5†	0.160 ?	10†	0.400 5	scin

No (0.120 γ)γ

R.C.Hanna, J.M.Freeman, J.O.Newton, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$\gamma(O^{16})$ $O^{(16)}$(fast n,p)

3†	1.7	2300†	(6.13)	scin,
1†	1.9		(7.12)	scin $\gamma\gamma$
30†	2.7			

(1.7, 1.9 γ)($E_\gamma > 6.4$) No (2.7 γ)($E_\gamma > 6.4$)
(2.7γ)($E_\gamma > 3.5$)(θ) contains significant terms in $\cos^4\theta$; $\eta(\pi) \sim +0.7$. See also O^{16}.
1% β branch to 8.87 level implied; $\log ft = 4.4$

D.H.Wilkinson, B.J.Toppel, D.E.Alburger, Phys. Rev. 101, 673 (1956).

$O^{16}_{8\ 8}$ Level $P^{19}(p,\alpha\gamma)$ $E_p = 1.3$ to 4.1

8.87 2 level $J = 2^{-*}$ scin pr,

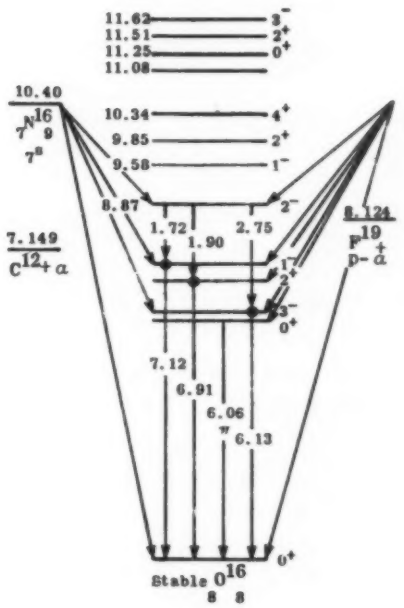
γ	3†	1.72 3	(6.13)	scin $\gamma\gamma$,
	1†	1.90 3	(6.91)	scin
	24†	2.75 2	(7.12)	

(2.75 γ)(6.13 γ) No (2.75 γ)(6.91, 7.12 γ)
(1.72, 1.90 γ)($E_\gamma > 6.3$) No 8.87γ (<3.8†)
*From γ intensities and (2.75 $\gamma\gamma$)3.13 γ)(θ)
This level is not predicted by α-particle model

D.H.Wilkinson, B.J.Toppel, D.E.Alburger, Phys. Rev. 101, 673 (1956), 99, 632A (1955).

$O^{16}_{8\ 8}$ $O^{(16)}(\gamma,n)$ $E_\gamma = 17.6$ to 17.9
No resonance observed O in liquid scin

J.G.Campbell, Australian J. Phys. 8, 449 (1955); Phys. Rev. 95, 1357 (1954).



$O^{17}_{8\ 9}$ Level $O^{(16)}(d,p)$ $E_d = 0.76$ to 1.40

(0.872) ppl

Values given of $a_o \cdots a_5$ in $\Sigma a_i P_i(\theta)$ for $d,p(\theta)$
Legendre coefficients vary greatly with E_d

N.K.Jurić, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 41 (1956).

Levels $C^{13}(\alpha,n)$ $E_\alpha = 2.0$ to 5.2

σ^*	Level	Γ(kev)	σ^*	Level	Γ(kev)
2.7	7.94	100	17	8.95	30
6.7	8.06	100	3.5	9.15	≤8
14	8.20	80	≥17	9.2	≤5
≥12	8.335	≤6	7.4	9.50	15
24	8.40	10	28	9.725	25
10	8.465	10	6	9.78	70
≥36	8.50	≤7	38	9.885	15
9.1	8.70	90	6.8	9.97	200
20	8.89	150	30	10.20	65

*mb/sterad, 0° to 20°

T.W.Bonner, A.A.Kraus, J.B.Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956); Bull. Am. Phys. Soc. 1, No. 1, 20 DA3 (1956).

Levels $C^{13}(\alpha,n)$ $E_\alpha = 1.5$ to 3.7; 0°
$O^{(16)}(n)$ $E_n = 4.4$ to 5.5

J	Level	J	Level	Γ_n/Γ_α
	8.06	≥ 3/2	8.51	
	8.21	3/2	8.71	~20
	8.35		8.91	
≥3/2	8.41		8.97	
	8.47		9.20	

Spins from $\sigma(0°)$ at resonance

R.L.Becker, H.H.Barschall, Phys. Rev. 102, 1384 (1956).

O^{18} 8 10 Levels $O^{17}(d,p)$ $E_d = 7.68, 7.83$
$O^{18}(d,d')$ 5 angles 28° to 90°
(1.986) sd
3.555 *13*
Levels predicted between 1.99 and 3.55 were not observed

D.R.Bach, P.V.C.Hough, Phys. Rev. 102, 1341 (1956).

F^{17} 9 8 Levels $N^{(14)}(\alpha,n)$ $E_\alpha = 8.16$
g.s. $Q = -4.76$ *7* a p-recoil,
0.53 *4* thresh n, ~0°

W.T.Doyle, A.B.Robbins, Phys. Rev. 101, 1056 (1956); 98, 1185A (1955).

F^{18} 9 9 Levels $O^{18}(p,n\gamma)$ $E_p = 2.5$ to 4.2
γ 0.94 2 $\tau > 0.1^{\mu\mu s}$* thresh n,
1.04 2 $\tau < 0.1^{\mu\mu s}$** scin
No other γ (< 2% of 0.94γ)
Doppler shift *not observed, **observed

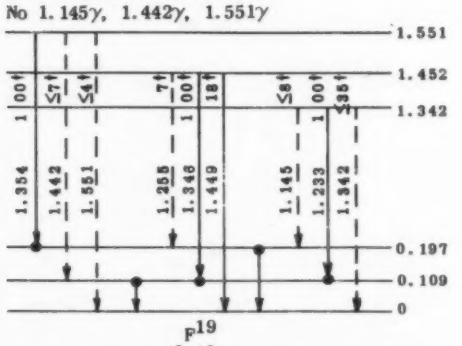
M.Roclawski-Conjeaud, V.Naggiar, D. Szteinszaider, J.Thirion, Amsterdam Conf. Nuclear Reactions, July 1956. Physica 22 (1956); Compt. rend. 242, 1443 (1956); verbal report.

Levels $O^{(16)}(d,p_1)$ $E_d = 1.7$ to 4.6
10°

9.18	
9.35	10.52
9.43	10.74
9.80	10.86
9.95	11.04
10.13	11.17
10.34	11.4

M.Roclawski-Conjeaud, E.Cotton, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22, 1956.

F^{19} 9 10 γ $F^{19}(p,p'\gamma)$ $E_p = 2.4$ to 4.1
(0.110) scin $\gamma\gamma$, scin pr
(0.197) 1.346 *10*
1.233 *10* 1.354 *10*
1.255 ? 1.449 *10*
(0.110γ)(1.233, 1.346γ) No (0.110γ)(1.449γ)
(0.197γ)(1.354γ) delay observed
p(~1.24γ)(θ) $\eta(0) = +0.3$
p(~1.35γ)(θ) $\eta(0) = -0.3$
No 1.145γ, 1.442γ, 1.551γ



F^{19} 9 10

†Relative number of transitions from level

B.J.Toppel, D.H.Wilkinson, D.E.Alburger, Phys. Rev. 101, 1485 (1956); 100, 1254A (1955).

F^{19} 9 10 γ $F^{19}(n,n'\gamma)$ $E_n = 1.5$ to 3.7
(0.110) scin
(0.197) 1.360 *12*
1.236 *12* 1.472 *16*
1.355 *12* 2.59* *4*
(0.110γ)(1.236, 1.356γ)
(0.197γ)(1.360γ)
*Threshold at ~3.5

J.M.Freeman, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Levels $F^{19}(p,p'\gamma)$ $E_p = 4.3$
0.197 level
μ +3.70* *45* p,$\gamma(\theta,H)$
1.55 level
γ 1.35 *4* scin
(1.35γ)(0.197γ) delay = 85*μs *5* (half-life)

M.Fiehrer, P.Lehman, A.Leveque, R.Pick, Compt. rend 241, 700, 1746 (1955); Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22, (1956); verbal report.

Levels $O^{18}(d,n)$ $E_d = 0.4$ to 4.5
6.184* *18*
8.48* *2*
*$l_n = 0$ from rate of rise of slow n yield

W.V.Harlow, J.B.Marion, R.A.Chapman, T.W. Bonner, Phys. Rev. 101, 214 (1956).

Level $O^{18}(p,\gamma)$ $E_p = 1.169$
9.068 J = 1/2
p(6.3γ)(θ) $\eta(0) = -0.15$

J.Butler, H.D.Holmgren, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Levels $O^{18}(p,n)$ $E_p = 2.5$ to 3.8

	Level	Γ(kev)	J	pc
40†	10.471 2	40		p,n(θ)
11†	10.542 *6*			
16†	10.586 2	35		
81†	10.839 2	60		
42†	10.957 2	45	3/2	
100†	11.050 2	65	1/2?	
93†	11.162 2	45	3/2	
58†	11.265 4		1/2?	
97†	11.365 *20*	85		
97†	11.511 *20*			

H.Mark, C.Goodman, Phys. Rev. 101, 768 (1956).

$F^{19}(\gamma,p)$ $E_\gamma \leq 16.5$; 235 tracks
For $E_p = 4.4$ to 8.5, $\sigma(\theta) \sim 1 + 15\sin^2\theta$ ppl
$E_p = 2.9$ to 4.4, $\sigma(\theta) \sim 10 + 19\sin^2\theta$

W.B.Lanich, E.G.Muirhead, G.G.Shute, Australian J. Phys. 8, 456 (1955).

P^{20} 9 11

Levels $P^{19}(d,p)$ $E_d = 0.75$ to 1.45; ppl

1.0†	g.s.	no stripping	d,p(θ)
2.7†	(0.65)	$l_n = 2$	
2.1†	(0.99), (1.06)	$l_n = 0$	

†Relative values of $\int d\sigma$ at $E_d = 1.0$

S. Takesoto, T. Dazai, R. Chiba, S. Suganomata, S. Ito, Phys. Rev. 101, 772 (1956).

Ne^{20} 10 10

Levels $P^{19}(p,\alpha\gamma)$ p res. calibration

Level	E_o	Γ(kev)	sπ
13.1935 3	0.3405 3	3.3 2	
13.6977 4	0.8713 4	4.5 2	

F. Bumiller, H.H. Staub, H.E. Weaver, Helv. Phys. Acta. 29, 83 (1956); 28, 355A (1955).

Ne^{22} 10 12

Levels $O^{18}(\alpha,n)$ $E_\alpha = 1.9$ to 5

σ^*	Level	Γ(kev)	σ^*	Level	Γ(kev)
0.3	11.47	30	16	12.63	~200
0.9	11.68	< 15	13	12.86	~40
2.3	11.75	25	16	13.03	~40
2.6	11.89	< 15	29	13.11	~40
5.2	12.07	~40	42	13.20	~100
9.2	12.31	~70	27	13.35	~70
			31	13.60	~40

*mb/sterad, 0° to 30°

T.W. Bonner, A.A. Kraus, J.B. Marion, J.P. Schiffer, Phys. Rev. 102, 1348 (1956).

Ne^{23} 10 13 40^s

β^- 3.9 3 $Na^{23}(n,p)$; scin

$\gamma(Na^{23})$ 0.440 5 scin

No 1.7, 3.0 γ's (< 10%, 1% of 0.440γ resp.)

$\beta\gamma/\beta = 1/3$ from Au^{198} comparison

H.J. Gerber, M.G. Muñoz, D. Maeder, Phys. Rev. 101, 774 (1956).

Ne^{24} 10 14 3.4^m

$Ne^{(22)}$(1.5-Mev t,p) chem

τ 3.38^m 2

β^-	8%	1.10 5	scin $\beta\gamma$
	92%	1.98 5	scin
$\gamma(Na^{24})$	8†	0.878 9	scin
(1.10β)(0.878γ)			scin

p $15^h Na^{24}$. Growth of 2.75γ observed

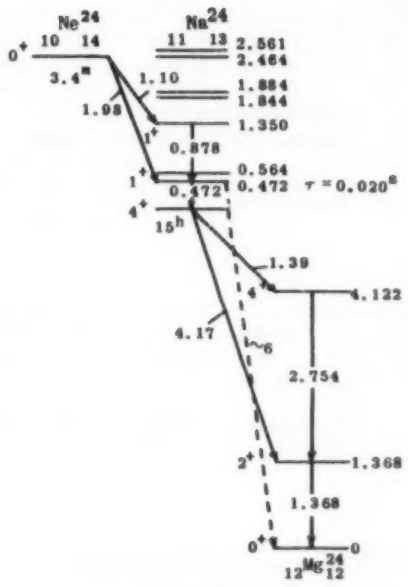
No 0.092γ, 0.564γ (<0.5†). No 0.785γ (<1†).

No γ with $E_\gamma > 1.2$ (<1†). p 0.02^s Na^{24}, q.v.

B.J. Dropsky, A.W. Schardt, Phys. Rev. 102, 426 (1956); 100, 954A (1955).

Continued

Ne^{24} 10 14 3.4^m



B.J. Dropsky, A.W. Schardt, Phys. Rev. 102, 426 (1956); 100, 954A (1955).

Na 11

Relative isotopic abundances ms

Na^{23} 100.0%

No Na^{21} ($< 1 \times 10^{-6}$%) No Na^{22} ($< 3 \times 10^{-6}$%)

F.A. White, T.L. Collins, F.M. Rourke, Phys. Rev. 101, 1786 (1956).

Na^{22}? 11 11

$Na^{23}(\gamma,n?\gamma)$ $E_\gamma \leq 22$

No γ with $\gamma\gamma$ delay $\geq 10^{\mu s}$ scin

S.H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).

Na^{23} 11 12

γ $Na^{23}(n,n'\gamma)$ $E_n = 2.5$; scin

0.45 1

1.69 3

E.A. Wolf, Phil. Mag. 1, 102 (1956).

Na^{24} 11 13 0.02^s

τ		0.020^s $^{+30}_{-15}$	$3.4^m Ne^{24}$ source
β^-		~6	scin
$\gamma(Na^{24})$		0.472 5	scin

d 3.4^mNe. Separated by electric field

Observation of expected 4.6 β^- prevented by presence of Ne^{23}

B.J. Dropsky, A.W. Schardt, Phys. Rev. 102, 426 (1956); 100, 954A (1955).

Na^{24} 11 13

Capture γ's Na^{23}(th n,γ) scin Cp

60†	0.48 *2*	5†	1.66 *5*
34†	0.86 *2*	12†	2.02 *3*
6†	1.35 *3*	19†	2.53 *3*

Study covered E_γ = 0.3 to 3
†Photons/100 Na captures, (±20%) (σ_a = 0.5)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

Na^{25} 11 14 62[s]

$\gamma(Mg^{25})$ $Mg^{(25)}$(fast n,p)

80†	0.37 *1*	74†	0.975 *10*	scin
100†	0.58 *1*		1.35 ?	

No 0.46γ

N.E.Nahmias, T.Yuasa, J. phys. radium 17, 373 (1956).

Mg 12

Relative isotopic abundances ms

Mg^{24}	78.8% *2*
Mg^{25}	10.15% *10*
Mg^{26}	11.06% *10*

No Mg^{21} ($<8 \times 10^{-5}$%) No Mg^{22} ($<25 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Mg^{25} 12 13

Capture γ $Mg^{(24)}$(th n,γ) scin Cp

49†	2.80 *3*

Study covered E_γ = 0.3 to 3
†Photons/100 Mg captures, (±20%) (σ_a = 0.057)
(Max in Mg^{25}, Mg^{26}, Mg^{27} = 44, 45, 11†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Mg^{26} 12 14

Capture γ's $Mg^{(25)}$(th n,γ) scin Cp

13†	1.07 *5*
22†	1.87 *3*

Study covered E_γ = 0.3 to 3
†Photons/100 Mg captures, (±20%) (σ_a = 0.057)
(Max in Mg^{25}, Mg^{26}, Mg^{27} = 44, 45, 11†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Mg^{27} 12 15 9.5[m]

$\gamma(Al^{27})$ $Mg^{(26)}$(pile n,γ) chem

0.66†	0.175 *15*	scin
70†	0.834	
30†	1.015	

β/γ = 1.00 *5* pc β, scin γ
No (0.834 γ)(1.015 γ) scin

W.S.Lyon, N.H.Lazar, Phys. Rev. 101, 1524 (1956).

Al 13

Relative isotopic abundances ms

Al^{27}	100.0%

No Al^{25}, Al^{26} ($<15 \times 10^{-5}$%)
No Al^{28}, Al^{30} ($<5 \times 10^{-5}$%)
No Al^{29} ($<2 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Al^{25} 13 12 7.6[s]

$Mg^{(24)}$(0.26-Mev p,γ)
No 0.98γ (<0.5%) scin γ/γ^2

T.Stribel, Z.Naturf. 11a, 166 (1956).

Al^{25} 13 12

Capture γ's $Mg^{(24)}$(p,γ) $E_p \sim 0.238$; scin

2.50 level E_o = 0.222 $\Gamma < 2$ kev

	0.454 *5*		
5†	0.97 *3*		
14†	1.56 *3*		
100†	2.05 *2*		

(0.454 γ)(2.05 γ) (0.97 γ)(1.56 γ)
p(2.05 γ)(θ) isotropic

D.S.Craig, Phys. Rev. 101, 1479 (1956).

Capture γ's $Mg^{(24)}$(p,γ) scin

2.50 level E_o = 0.222

	0.46 *5*	10†	1.54 *5*
	0.95 *7*	100†	2.04 *3*

2.69 level E_o = 0.418

	0.45 *5*	80†	1.33 *3*
330†	0.85	50†	1.80 *2*
	0.88 *3*	110†	2.24 *2*
	0.95	100†	2.69 *2*

3.08 level E_o = 0.825

	0.45 *4*		
	0.95 *3*	100†	2.62 *2*
>6†, <20†	2.12 *3*	40†	3.08 *3*

H.Ager-Hanssen, O.M.Lönsjö, E.Nordhagen, Phys. Rev. 101, 1779 (1956).

Al^{26} 13 13

Levels $Na^{23}(\alpha,n)$ E_α = 8.16

g.s.	Q = −2.9 *2*	a p-recoil
0.3 *2*		thresh n, ~0°
1.0 *2*		
1.4 *2*	2.5 *2*	
1.8 *2*	2.9 *2*	

[*]6.7[s] β^+ first appears at Q = −3.2 *2* scin γ^2

W.T.Doyle, A.B.Robbins, Phys. Rev. 101, 1056 (1956).

Al^{27} 13 14

	ground state	
J	5/2	I
$\lvert\mu\rvert$	3.6385 *3*	

L.C.Brown, D.Williams, J.Chem. Phys. 24, 751 (1956).

Al^{27} 13 14

Levels $Mg^{26}(d,n)$ $E_d = 1.0, 6.0$ ppl; $d,n(\theta)$

Level	l_p
1.00	2
2.31	3
2.94	1
6.75	0
8.2	1

B. Trumpy, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Al^{28} 13 15 2.3m

τ 2.31m *6* Si^{28}(12.5-Mev n,p)

A. V. Cohen, P. H. White, Nuclear Phys. 1, 73 (1956).

Al^{28} 13 15

Levels $Al^{27}(d,p)$ $E_d = 6, 7$; several angles, s

g.s.	Q = 5.502	3.294
0.029	2.279	3.294
0.973	2.490	3.347
1.017	2.589	3.461
1.372	2.663	3.537
1.633	2.968	3.591
2.143	3.011	3.669
2.207	3.102	3.704

78 additional levels from 3.878 to 7.731 listed

W. W. Buechner, M. Nazari, A. Sperduto, Phys. Rev. 101, 188 (1956); 99, 644A (1955).

Capture γ's Al^{27}(th n,γ) scin Cp

10†	0.97 *3*
14†	2.26 *3*
42†	2.5 to 3.1

†Photons/100 Al captures, (±20%) (σ_a = 0.21)

T. H. Braid, Phys. Rev. 102, 1109 (1956).

Si^{28} 14 14

Resonance $Al^{27}(p,\gamma)$ sπ,p res. calibr.

0.9906 *2*

F. Bumiller, H. H. Staub, H. E. Weaver, Helv. Phys. Acta 29, 83 (1956).

Si^{29} 14 15

Capture γ's $Si^{(28)}$(th n,γ) scin Cp

14†	1.26 *3*
19†	2.13 *3*
11†	2.65 *3*
49†	3.60 *6*

†Photons/100 Si captures, (±20%) (σ_a = 0.16)

(Max in Si^{29}, Si^{30}, Si^{31} = 74, 13, 13†)

T. H. Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Si^{29} 14 15

Resonances $Si^{(28)}(n,p)2.3^m Al$

0.03°	5.14 ?	E_n = 4.4 to 8.0
0.09°	5.62 *5*	
0.28°	6.51 *5*	
0.35°	6.81 *5*	
0.37°	7.45 *10*	$\Gamma \sim 0.3$

°Peak σ's (±50%)

J. B. Marion, R. M. Brugger, R. A. Chapman, Phys. Rev. 101, 247 (1956).

Si^{30} 14 16

Levels $Al^{27}(\alpha,p)$ E_α = 8

g.s.	Q = 2.38 *3*	ppl, pc, scin
2.23 *2*		4 angles
3.52 *2*		
3.80 *4*	5.94 *4*	
4.83 *2*	6.52 *3*	
5.28 *2*	7.10 *3*	
5.52 *3*	7.38 *5*	

No 5.07, 5.62 levels

F. L. Hassler, F. E. Steigert, G. F. Pieper, Bull. Am. Phys. Soc. 1, No. 6, 280 B4 (1956).

P^{29} 15 14

Levels $Si^{28}(p,p' + 1.78\gamma)$ scin

w	5.27		
64†	5.72	w	6.56
	5.95		6.82
	6.18		7.01
	6.31		7.25
w	6.47		7.44
w	6.52	w	7.48

†$\sigma(0°)$ in mb/sterad

H. B. Willard, J. K. Bair, H. O. Cohn, J. D. Kington, Bull. Am. Phys. Soc. 1, No. 5, 264 F4 (1956); Phys. Rev. 99, 644A (1955); verbal report.

P^{30} 15 15 2.5m

τ 2.56m *15* P^{31}(18-Mev p,pn)

β^+ 3.24 *4* sl

No ce No 2.32γ sl ce, scin

D. Green, J. R. Richardson, Phys. Rev. 101, 776, (1956); 96, 858A (1954).

P^{31} 15 16

Levels $P^{31}(p,p')$ E_p = 3.0, 4.6 sd; 90°

1.264 *4*
2.234 *8*
3.133 *10*
3.290 *10*

D. M. Van Patter, C. P. Swann, N. A. Rothman, W. C. Porter, C. E. Mandeville, Amsterdam Conf. Nuclear Reactions, July 1956; Bull. Am. Phys. Soc. 1, No. 1, 39 JA1 (1956); verbal report; Physica 22 (1956).

P^{32} 15 17 14d

$S^{(32)}(n,p)$

β^- 1.712 *4* F-K linear sl

A. V. Pohm, R. C. Waddell, E. N. Jensen, Phys. Rev. 101, 1315 (1956).

P^{32} 15 17 14^{d}

$e^{+}/\beta^{-} = 7.5\times10^{-10}$ *20* sl $\gamma^{\pm}\gamma^{\pm}$
Not corrected for external pair creation
Theoretical value* for internal pair creation is 5.5×10^{-10}

J.S.Greenberg, M.Deutsch, Phys. Rev. 102, 415 (1956); 99, 665A (1955); *K.Huang, Phys. Rev. 102, 422 (1956).

$S^{(32)}(n,p)$ chem
$e^{+}/\beta^{-} < 1.3\times10^{-5}$ cc
No new light positive particle ($< 8\times10^{-4}$%)
Spectral shape of internal bremsstrahlung agrees with theory scin

A.B.Milojević, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 21 (1956).

P^{32} 15 17

Capture γ's P^{31}(th n,γ) scin Cp

28†	0.51 *2*		
14†	1.13 *3*		
41†	2.19 *3*		

Study covered E_γ = 0.3 to 3
†Photons/100 P captures, (±20%) (σ_a = 0.19)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

S^{32} 16 16

Levels Cl^{35}(p,α) E_p = 7.04 s,
g.s. Q = 1.863 *8* 90°, 130°

2.237	
3.780	4.465
4.287	4.698

P.M.Endt, C.H.Paris, Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

S^{33} 16 17

Capture γ's $S^{(32)}$(th n,γ) scin Cp

56†	0.84 *2*		
1†	1.52 *5*		
37†	2.34 *3*		

Study covered E_γ = 0.3 to 3
†Photons/100 S captures, (±20%) (σ_a = 0.49)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

S^{34} 16 18

Levels Cl^{37}(p,α) E_p = 7.04 s,
g.s. Q = 3.026 *8* 90°, 130°

2.127	4.114
3.302	4.621
3.915	4.685
4.073	4.876

P.M.Endt, C.H.Paris, Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

S^{37} 16 21 5.0^{a}

$\gamma(Cl^{37})$ 3.09 *3* $Cl^{(37)}$(fast n,p); scin

T.Stribel, Z. Naturf. 11a, 254 (1956).

Cl^{34} 17 17 32^{m}

τ 32.40^{m} *4* $Cl^{(35)}$(18-Mev p,pn)
β^{+} 26† 1.33 *10* sl
26† 2.48 *7*
47† 4.50 *3* F-K linear (E_β > 3.0)

D.Green, J.R.Richardson, Phys. Rev. 101, 776 (1956); 96, 858A (1954).

Cl^{35} 17 18

Levels Cl^{35}(p,p′) E_p = 7.04
s 90°, 130°

1.221	
1.763	3.165
2.645	4.058
2.695	4.113
3.006	4.174

P.M.Endt, C.H.Paris, Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

Cl^{36} 17 19 $3.1\times10^{5}y$

β^{-} 0.714 *4* 4π scin
For E_β > 0.089 shape is fitted with ΔJ=2 no, $R_{ij}/T_{ij} = 0$ and $A_{ij}/T_{ij} = 14.2$

R.G.Johnson, O.E.Johnson, L.M.Langer, Phys. Rev. 102, 1142 (1956); Bull. Am. Phys. Soc. 1, No. 4, B1 162 (1956).

Cl^{36} 17 19

Levels $K^{(39)}$(n,α) E_n = 2.0 to 5.5
g.s. Q = 1.25 *20* KI scin
0.87 *10*

M.J.Scott, R.E.Segel, Phys. Rev. 102, 1557 (1956).

Capture γ's $Cl^{(35)}$(th n,γ) scin Cp

10†	0.48 *3*	34†	1.96 *3*
10†	0.75 *3*	1†	2.42 *5*
8†	1.14 *3*	6†	2.84 *3*

Study covered E_γ = 0.3 to 3
†Photons/100 Cl captures, (± >20%)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 355A (1953).

Cl^{37} 17 20

Levels Cl^{37}(p,p′) E_p = 7.04
0.838 s 90°, 130°
1.728

P.M.Endt, C.H.Paris, Bull. Am. Phys. Soc. 1, No. 4, 223 W1 (1956).

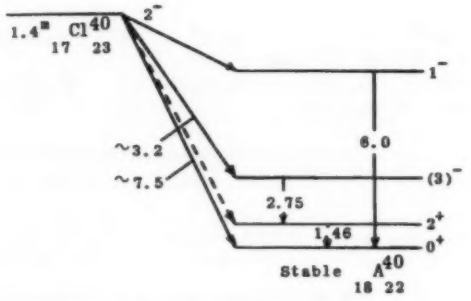
Cl^{39} 17 22 56^{m}

β^{-} 93.5% 1.90 *5* $A^{(40)}$(α,αp); sl
6.5% 3.43 *5*
$\gamma(A^{39})$ 100† 0.246 scin
100† 1.266 *10*
84† 1.520 *10*
β(high E_γ) delay = 0.95$^{m\mu s}$ *5*
(0.246 γ)(1.27 γ) No (1.52 γ)γ

J.R.Penning, H.R.Maltrud, J.C.Hopkins, F.H. Schmidt, Bull. Am. Phys. Soc. 1, No. 4, 162 B2 (1956); verbal report.

Cl^{40} 17 23 — 1.4^m

τ	1.4^m	$A^{(40)}$(fast n,p)	chem
β^-	~3.2		scin
	~7.5		
$\gamma(A^{40})$	100† 1.46		scin
	100† 2.75		
	6.0		



H.Morinaga, Phys. Rev. 103, 504 (1956); H.Morinaga, E.L.Robinson, E.Bleuler, Bull. Am. Phys. Soc. 1, No. 4, 162 B3 (1956).

A^{37} 18 19 — 34^d

For $E_\gamma > 0.035$ γ continuum has allowed shape and intensity is 1.05 ± 0.25 times theoretical value

B.Saraf, Phys. Rev. 102, 466 (1956).

A^{39} 18 21

Levels	$K^{(39)}$(n,p)	E_n = 2.0 to 5.5
g.s.	(Q = 0.20)	KI scin
1.24 *5*		
2.46 *10*		

No 1.52 level (yield < 1/3 that of 1.24 level)

M.J.Scott, R.E.Segel, Phys. Rev. 102, 1557 (1956).

K 19

Relative isotopic abundances ms

K^{39}	93.23% *5*
K^{40}	0.0118% *2*
K^{41}	6.76% *5*

No K^{36}, K^{37}, K^{38} ($< 8 \times 10^{-6}$%)

No K^{42} ($< 4 \times 10^{-6}$%) No K^{43} ($< 2 \times 10^{-6}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

K^{38} 19 19 — 7.7^m

τ	7.7^m *3*	$K^{(39)}$(18-Mev p,pn)	
β^+	2.68 *3*		sl
No ce	No 4.9 β^+ (< 0.6%)		

D.Green, J.R.Richardson, Phys. Rev. 101, 776 (1956); 96, 858A (1954).

K^{39} 19 20

Levels	$A^{36}(\alpha,p)$	E_α = 7.4
g.s.	Q = −1.28 *3*	ppl 90°
2.50		
2.87		

R.B.Schwartz, J.W.Corbett, W.W.Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955).

K^{40} 19 21 — 1.3x10^{9y}

τ	1.28x10^{9y} *2*		
γ	1.46 *1*		scin
27.5 *3* β^-'s/sec g K			pc β
γ/β = 0.124 *2*	Co^{60} standard		pc β, scin γ
= 0.121 *4*	Na^{24} standard		

A.McNair, R.N.Glover, H.W.Wilson, Phil. Mag. 1,199 (1956); Phys. Rev. 99, 771 (1955).

K^{40} 19 21

Capture γ's	$K^{(39)}$(th n,γ)		scin Cp
24† 0.77 *3*		13† 2.03 *3*	
8† 1.19 *3*		6† 2.80 *3*	
5† 1.61 *3*		8† 3.45 *5*	

†Photons/100 K captures, (±20%) (σ_a = 1.89)
(Max in K^{40}, K^{41}, K^{42} = 95.5, 0.4, 4.1†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

K^{42} 19 23 — 12.5^h

β^-	1† 0.5 ?	K^{41}(pile n,γ); sl	
	100† 1.985 *10*	F-K linear	
	3.545 *10*	ΔJ = 2, yes shape	
$\gamma(Ca^{42})$			
0.8†† 0.320 *5*			sl pe
100†† 1.53 *1*			

A.V.Pohm, R.C.Waddell, E.N.Jensen, Phys. Rev. 101, 1315 (1956).

K^{43} 19 24

Levels	$A^{40}(\alpha,p)$	E_α = 7.4
g.s.	Q = −3.36 *3*	ppl 90°
0.65		
1.18		

R.B.Schwartz, J.W.Corbett, W.W.Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955).

Ca^{40} 20 20

Levels	$Ca^{(40)}$(p,p'γ)	E_p = 6.54 to 8.15
3.348 *4*		sπ 90°
3.730 *4*	5.272 *6*	
3.900 *4*	5.606 *9*	
4.483 *5*	5.621 *8*	
5.202 *8*	5.901 *8*	
5.241 *6*	6.029 *8*	

C.M.Braams, Phys. Rev. 101, 1764 (1956).

Ca^{41} 20 21

Capture γ's	$Ca^{(40)}$(th n,γ)	scin Cp
15† 0.48 *5*		
45† 1.93 *3*		

Study covered E_γ = 0.3 to 3
†Photons/100 Ca captures, (± 20%)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Ca^{48} 20 28

$\tau_{\beta\beta}$	84.28% Ca^{48}; 4π scin	
	> 2x10^{18y}	$\beta\beta$
	> 1.1x10^{18y}	β

Search covered $3.0 < E_\beta < 4.75$
Long τ suggests ν and anti-ν are nonidentical

M.Awschalom, Phys. Rev. 101, 1041 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31, H7 (1956).

Ca^{49} 20 29, 8.8d

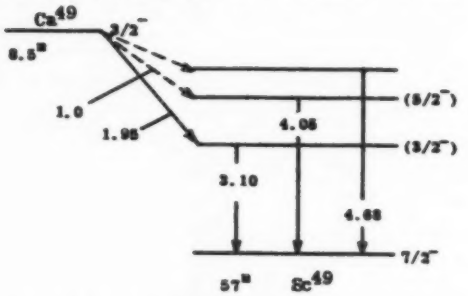
τ		8.9m 2	Ca^{48}(pile n,γ)
β^-		~1.0	a$\beta\gamma$
		2.12 *10*	
$\gamma(Sc^{49})$	85†	3.07 *5*	scin
	10†	4.04 *6*	
	0.8†	4.7 *1*	

(~1.0β)(4.04γ) (2.12β)(3.07γ)
No 5.2β (< 1%) No 0.98γ (< 3†)
No $\gamma\gamma$

D.W.Martin, J.M.Cork, S.B.Burson, Phys. Rev. 102, 457 (1956); 100, 1236A (1955).

τ		8.75m *20*	Ca^{48}(pile n,γ)
β^-	14†	0.89 *15*	scin
	100†	1.95 *5*	
$\gamma(Sc^{49})$			
	100††	3.10 *3*	scin
	11††	4.05 *5*	
	0.38††	4.68 *5*	

$\beta\gamma$(3.10γ) = 0.95 *10* 4π ic,scin
No (3.10γ)(4.05, 4.68γ) No 0.95γ (< 2†)



G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 101, 1059 (1956).

Sc 21 — Relative isotopic abundances ms
Sc^{45} 100.0%
No Sc^{42}, Sc^{43}, Sc^{44}, Sc^{46} (< 0.010%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Sc^{46} 21 25, 84d, s.s.

β^- 0.0036%* 1.475 *6* F-K not linear sl
*Assuming $\alpha = 9.86\times10^{-5}$ for 1.12γ and shape factor $p^2+0.6q^2$

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

Sc^{47} 21 26, 3.4d

			Ca^{44}(23-Mev α,p) chem
β^-	60%	0.439 *2*	sl,scin
	40%	0.600 *2*	
$\gamma(Ti^{47})$		0.159 *2*	$\beta\gamma$ delay < 0.04μs sl pe,scin

(0.439β)γ No (0.600β)γ scin

W.E.Graves, S.K.Suri, Phys. Rev. 101, 1368 (1956).

Sc^{48} 21 27, 1.8d

$\beta\gamma$ delay < 0.1μs
(1.04γ)(1.33γ)(θ)
(1.04γ)(0.99γ)(θ)
} J = 6, 4, 2, 0 — $V^{(51)}$(d,αp) chem scin

B.Van Nooijen, P.Moatert, J.F.Van der Brugge, P.M.Endt, Physica 22, 194 (1956).

Sc^{49} 21 28, 57m

τ		57.2m 7	$Ca^{(48)}$(pile n,$\gamma\beta$) chem
β^-	100%	2.05 5	scin
No 1.35γ (< 0.05%)			bremsstrahlung/β
No other γ			

G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 101, 1059 (1956).

β^- 1.8 *1* Ca^{48}(pile n,$\gamma\beta$); a

D.W.Martin, J.M.Cork, S.B.Burson, Phys. Rev. 102, 457 (1956).

Ti^{49} 22 27

Capture γ's	$Ti^{(48)}$(th n,γ)	scin Cp
29†	0.33 *2*	
90†	1.40 *3*	
≤10†	~1.7	

Study covered E_γ = 0.3 to 3
†Photons/100 Ti captures, (±20%)
(Max in Ti^{47}, Ti^{48}, Ti^{49}, Ti^{50}, Ti^{51} = 0.7, 2.2, 95, 1.7, 0.3†)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 90, 335A (1953).

V 23 — Relative isotopic abundances ms
V^{50} 0.25% *1*
V^{51} 99.75% *1*
No V^{48} (< 1 x 10^{-4}%) No V^{49} (< 5 x 10^{-5}%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

V^{51} 23 28

ground state
q +0.28 *15* S

K.Murakawa, J. Phys. Soc. Japan 11, 422 (1956).

γ	$V^{(51)}$(n,n'γ)	E_n = 2.5; scin	
	0.32 *2*		
	0.48?	1.62 *4*	
	0.92 *4*	1.83 *4*	

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

V^{52} 23 29

Capture γ's	$V^{(51)}$(th n,γ)			scin Cp
5†	0.42 *3*	8†	0.84 *3*	
6†	0.63 *3*	5†	2.25 *3*	

Study covered E_γ = 0.3 to 3
†Photons/100 V captures, (±20%) (σ_a = 4.7)
(Max in V^{51}, V^{52} = 12, 88†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

V^{53} 23 30 1.7[m]

τ		1.7[m]	Cr^{53}(5.3-Mev n,p)
β^-		2.53 5	scin
$\gamma(Cr^{53})$	st	1.00 1	scin
	w	1.29	

A.W.Schardt, B.J.Dropesky, Bull. Am. Phys. Soc. 1, No. 4, 162 B4 (1956); verbal report.

V^{54} 23 31 55[s]

τ	55[s]	5	Cr^{54}(16-Mev n,p)
β^-	3.3	2	scin
$\gamma(Cr^{54})$	0.835	9	$0.9 < E_\gamma < 2.2$ scin
	0.990	10	2.25

0.835 γ more intense than 0.990 γ
$(0.835\gamma)(0.990\gamma)(E_\gamma > 1)$

A.W.Schardt, B.J.Dropesky, Bull. Am. Phys. Soc. 1, No. 4, 162 B4 (1956); verbal report.

Cr 24

Level	Cr(n,n'γ)		E_n = 2.5
σ = 0.6	1.45	5	scin n
γ	1.44	3	scin γ

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

Capture γ's	Cr(th n,γ)			scin Cp
2†	0.52	3		
40†	0.83	3	10† 2.28	3
6†	1.84	3	4† 3.04	3

Study covered E_γ = 0.3 to ~3
†Photons/100 Cr captures, (±20%) $(\sigma_a = 2.99)$
(Max in Cr^{51}, Cr^{53}, Cr^{54}, Cr^{55} = 23, 20, 56, 0.21)

T.H.Braid, Phys. Rev. 102, 1109 (1956); 91, 442A (1953).

Cr^{51} 24 27 27[d]

$\gamma(V^{51})$	0.325	α = 0.0015	2	sl ce,Cp

Z.O'Friel, A.H.Weber, Phys. Rev. 101, 1076 (1956).

Cr^{55} 24 31 3.5[m]

No γ (<0.01%) Cr^{54}(n,γ)

T.H.Handley, S.A.Reynolds, CF-56-3-65; Nuclear Sci. Abstr. 10, No. 3243 (1956).

Mn 25

Relative isotopic abundances ms
Mn^{55} 100.0%
No Mn^{53} (<4 x 10^{-4}%) No Mn^{54} (<3 x 10^{-4}%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Mn^{54} 25 29

Mn^{55}(≤24-Mev γ,n)
No 2.1[m] activity ($\int\sigma dE$ < 0.1 mb Mev)

J.Goldemberg, Acad. Brasileira Ciencias 27, LIV (1955).

Mn^{55} 25 30

Level	Mn^{55}(n,n'γ)	E_n = 0.13 to 2
γ	(0.128)	scin γ

Graph of σ from threshold < E_n < 2
Hanser-Feshbach theory for σ favors $J = 9/2^-$

J.B.Guernsey, A.Wattenberg, Phys. Rev. 101, 1516 (1956).

γ	Mn^{55}(n,n'γ)	E_n = 0.2 to 1.2
	(0.128)*	scin γ
	0.84 4	

*Hauser-Feshbach theory for σ favors $J = 7/2^-$

J.J.VanLoef, D.A.Lind, Phys. Rev. 101, 183 (1956); 99, 621A; 98, 224A (1955).

Levels	Mn^{55}(n,n'γ)			E_n = 2.5
σ = 0.4	0.94	5		scin n
0.3	1.37	5		
0.1	1.65	5		
γ	0.126	5		scin γ
	0.32	2	1.53 3	
	0.86	3	1.87?	
	1.21	3	2.27 4	

(0.126 γ)(0.86, 1.21, 1.53, 2.27 γ) scin
No (0.126 γ)(1.87 γ)

L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

Fe 26

Resonance peaks	Fe(n) E_0(kev)	I_n		Li(p,n) E_0(kev)	I_n
st	8.0		w	36 ?	
w	16 ?		st	74.5	0
st	28.8	0	st	84.5	0

J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

Fe^{55} 26 29 2.9[y]

For $E_\gamma > 0.1$ γ continuum has allowed shape and intensity is 1.10 ±0.25 times theoretical value

B.Saraf, Phys. Rev. 102, 466 (1956).

Co^{57} 27 30 270[d]

$\gamma(Fe^{57})$		$Fe^{(56)}$(18-Mev d,n)	chem
No 0.029γ (<3% of 0.0144γ)			pc

No other γ with $0.009 < E_\gamma < 0.048$

N.A.Grace, O.A.Jones, J.O.Newton, Phil. Mag. 1, 363 (1956).

Co^{58} 27 31 72[d] g.s.

$\gamma(Fe^{58})$				Mn^{55}(α,n)	chem
1.6†	(0.81)*	E2/M1 = 4.8	13		$\gamma\gamma(\theta)$
100†	0.814*	10			scin
0.5†	1.62	2			

(0.81γ)(0.814$\gamma\gamma(\theta)$ J = 2, 2, 0
*$\Delta E < 0.010$ No 0.50γ scin $\gamma\gamma$

M.Frauenfelder, N.Levine, A.Rossi, S.Singer, Phys. Rev. 103, 352 (1956); Bull. Am. Phys. Soc. 1, No. 4, 163 B6 (1956).

$Rb^{89}_{37\ 52}$ 15^m

d $3^m Kr$ from U^{235}(n, f) chem

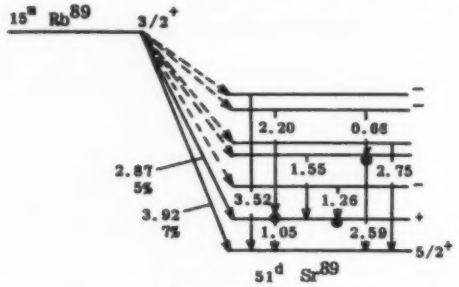
τ 14.9^m 3

β^- 5% 2.81 15 scin
7% 3.92

$\gamma(Sr^{89})$

217†	0.663	6	190†	2.20	2 scin
1000†	1.05	2	169†	2.59	3
717†	1.26	1	37†	2.75	5
48†	1.55	3	29†	3.52	7

(1.05 γ)(1.26 γ) (2.59 γ)(0.663 γ) Σ scin, scin
(1.05 γ)(2.20 γ) No γ(2.75, 3.25 γ) Σ scin



G.D.O'Kelley, N.H.Lazar, E.Eichler, Phys. Rev. 102, 223 (1956).

$Sr^{89}_{38\ 51}$ 51^d

τ 51^d 1 U(150-Mev p) chem

A.Kjelberg, A.C.Pappas, Nuclear Phys. 1, 322 (1956).

$Sr^{(88)}$(pile n, γ) chem

β^- 100% 1.462 5 $\Delta J = 2$, yes shape sl
Not p $14^m Y^{89}$ ($< 5 \times 10^{-4}$%) no 0.91γ scin

A.Bisi, S.Terrani, L.Zappa, Nuovo Cim. 2, 1297 (1955).

$Y^{88}_{39\ 49}$ 106^d g.s.

β^+ 0.58 Sr(10-Mev d); sd
No 0.83β (ascribed to internal pair's from 1.83 γ)

W.L.Stirling, N.Goldberg, Bull. Am. Phys. Soc. 1, No. 6, 291 K6 (1956).

$\gamma(Sr^{88})$ $Sr^{(88)}$(p, n) chem

92†	0.908	scin
100†	1.85	
0.5†	2.76	

(0.908 γ)(1.85 γ) Σ scin

N.H.Lazar, E.Eichler, G.D.O'Kelley, Phys. Rev. 101, 727 (1956).

$\gamma(Sr^{88})$ (0.91) 100% dipole $\gamma\gamma(\theta)$
(1.85) 100% quadrupole
(0.91 γ)(1.85 γ)(θ) J = 3, 2, 0

E.D.Klema, Phys. Rev. 102, 449 (1956); Bull. Am. Phys. Soc. 1, No. 2, 85 D2 (1956).

$Y^{88}_{39\ 49}$ 105^d g.s.

$\gamma(Sr^{88})$ (0.91) parity change $\gamma\gamma(t_{\frac{1}{2}})$
(1.85) no parity change
E2 sπ $e^+e^-(\theta)$

C.F.Coleman, Phil. Mag. 1, 166 (1956).

$Y^{88}_{39\ 49}$

γ $Y^{89}(\gamma, n\gamma)$ $E_\gamma \leq 22$; scin
0.045 5*
0.393 15 $\tau = 0.287^{ns}$ 15

*Assignment uncertain

S.H.Vegors, Jr., P.Axel, Phys. Rev. 101, 1067 (1956).

$Y^{90}_{39\ 51}$ 64^h

τ 64.8^h d Sr^{90} chem
Followed for 14 half lives

E.V.Narathe, J. Sci. Industrial Res. India 14B, 354 (1955).

$e^+/\beta^- = 3.6 \times 10^{-5}$ 9 sl, $\gamma^\pm\gamma^\pm$
e^+ chiefly from nuclear pairs from 1.75 transition in Zr^{90}

J.S.Greenberg, M.Deutsch, Phys. Rev. 102, 415 (1956).

$Zr^{89}_{40\ 49}$

$Zr^{(90)}(\gamma, n)$ β tron
Threshold for $4.3^m Zr^{89}$ (J = 1/2) = 12.37 9
Yield of $79^h Zr^{89}$ (J = 9/2) small below 12.37

P.Axel, J.D.Fox, Phys. Rev. 102, 400 (1956); 100, 1249A (1955).

$Zr^{96}_{40\ 56}$

$\tau_{\beta\beta}$ 85% Zr^{96}; 4π scin
$> 5 \times 10^{17}$y $\beta\beta$
$> 3.6 \times 10^{17}$y β

Search covered $2.5 < E_\beta < 4.5$
Long τ suggests ν and anti-ν are nonidentical

M.Awschalom, Phys. Rev. 101, 1041 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31 H7 (1956).

$Zr^{97}_{40\ 57}$ 17^h

U(n, f) chem

$\gamma(Nb^{97})$ 0.58 3 ? scin $\gamma\gamma$
1† 1.02*3 scin
2† 1.15 2
0.5† 1.72 3

(1.15γ)(0.58γ?) scin
β(1.02, 1.15, 1.72γ)
Also observed 1.28, 1.77γ (< 0.5†)
†Relative to intensity of 96 for $60^m Nb^{97}$ 0.75γ
*Present after Zr chem; intensity grows. See Nb^{97}

R.Nordhagen, J.Thomassen, Nuclear Phys. 1, 499 (1956).

Nb 41

Relative isotopic abundances ms
Nb^{93} 100.0%
No Nb^{89}, Nb^{90} ($< 12 \times 10^{-5}$%)
No Nb^{91}, Nb^{92}, Nb^{94} ($< 19 \times 10^{-5}$%)
No Nb^{95}, Nb^{96}, Nb^{97}, Nb^{98} ($< 1 \times 10^{-4}$%)

F.M.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Zn^{66} 30 36

Capture γ's $Cu^{65}(p,\gamma\gamma)$ $E_p = 1.9$ scin

0.83 2		
1.04 *1*	2.72 4	
1.37 2	3.39 ?	
1.71*	3.76 5	
1.78 *3* ?	4.12 5	
2.17 4	4.33 5	
2.41 4	4.52 5 ?	
2.48*	$4.5 < E_\gamma < 10$	

(1.04 γ)(0.83, 1.37, 1.71, 2.17, 2.48, 2.72 γ)
*Observed only in coincidence spectra

C.E.Weller, J.C.Grosskreutz, Phys. Rev. 102, 1149 (1956); 99, 655A (1955).

Zn^{67} 30 37

Level $Zn^{(67)}(\gamma,\gamma)$ $E_\gamma \leq 22$; scin
γ 0.090 5 $\gamma\gamma$ delay = $8.8^{\mu s}$ *10*

S.H.Vegors,Jr., P.Axel, Phys. Rev. 101, 1067 (1956).

Ga^{68} 31 37 68^m

β^+ 4.1† (0.92) 275^d Ge^{68} source; sl
100† 1.94 5
$\gamma(Zn^{68})$ 7† 1.02 2 scin
$\beta^+/1.02\gamma = 14.4$ *17* (if no Ge^{68} β^+) scin $\gamma^\pm/\gamma$

B.Crasemann, D.E.Rehfuss, H.T.Easterday, Phys. Rev. 102, 1344; Bull. Am. Phys. Soc. 1, No. 5, 253 F6 (1956).

Ga^{70} 31 39

Resonances $Ga^{69}(n)$ chopper

$\sigma_o(10^3 b)$	E_o(ev)	Γ(ev)	Γ_n(ev)
1.8 4	112	0.36 2	0.06
1.5	340	0.49	0.19
1.5 2	710	1.6 2	1.3

Assumed $\Gamma_\gamma = 0.3$ ev and $g = 1/2$

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Ga^{72} 31 41

Resonances $Ga^{71}(n)$ chopper

$\sigma_o(10^3 b)$	E_o(ev)	Γ(ev)	Γ_n(ev)
2.7 *10*	95	0.37 4	0.07
4.3 *1*	290	7.7 5	7.4
3.1 *1*	380	3.6 5	3.3
0.7 2	770	0.52 *10*	0.22

Assumed $\Gamma_\gamma = 0.3$ ev and $g = 1/2$

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Ga^{74} 31 43 $\sim 8^m$

τ $\sim 8^m$ $Ge^{(74)}$(fast n,p)
$\gamma(Ge^{74})$ 0.58 scin
2.3
2.6

H.Morinaga, Phys. Rev. 103, 504 (1956).

Ge^{68} 32 36 275^d

τ 275^d *20* $Zn^{(66)}$(37-Mev α,2n) chem
No β^+ with $E_\beta > 0.3$ sl

B.Crasemann, D.E.Rehfuss, H.T.Easterday, Phys. Rev. 102, 134; Bull. Am. Phys. Soc. 1, No. 5, 253 F6 (1956).

As^{75} 33 42

	ground state	
μ	+1.45 *15*	S
q	+0.32 5	

K.Murakawa, S.Suwa, Rept. Inst. Sci. Technol. Univ. of Tokyo 6, 209 (1952).

γ $As^{75}(\gamma,\gamma)$ $E_\gamma \leq 22$; scin
0.305 *15* $\gamma\gamma$ delay = 12^{ns} *3*

S.H.Vegors,Jr., P.Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

As^{76} 33 43 26.5^h

β^-	1.77 2	F-K linear*	sl $\beta,\beta\gamma$
	2.42 *1*	F-K linear*	
	2.97 *1*	$\Delta J = 2$, yes shape*	sl

*$E_\beta \geq 1$

A.V.Pohm, R.C.Waddell, E.N.Jensen, Phys. Rev. 101, 1315 (1956).

Se^{75} 34 41 127^d

(0.124 γ)(0.281 γ)(θ) $\eta(\pi) = -0.51$ *3* scin
(0.138 γ)(0.269 γ)(θ) $\eta(\pi) = +0.024$ *45*

Agree with J = 1/2 to 5/2, 3/2(5/2), 1/2(3/2), 3/2 for As^{75} levels at 0.405, 0.281, 0.269, g.s.
Probably no $P_4(\cos\theta)$ terms

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

Kr^{85} 36 49 10^y g.s.

Charges 1 to 10 (av. = 1.51) found on recoils
Charge distribution given s Rb^{85} recoil

A.H.Snell, F.Pleasonton, Bull. Am. Phys. Soc. 1, No. 5, 263 E7 (1956); No. 1, 42, K6 (1956).

Rb^{88} 37 51 18^m

$Rb^{(87)}(n,\gamma)$
β^- 76% (5.30) 4π pc 1.85γ/β
$\gamma(Sr^{88})$

631†	0.908 4	14†	3.01 5	scin
62†	1.39 *3*	14†	3.24 *3*	
1000†	1.850 *8*	11†	3.52 5	
45†	2.11 *3*	4†	3.68 5	
107†	2.68 5	14†	4.87 5	

(1.85 γ)(1.39, 2.11, 2.68 γ) (2.11 γ)(0.908 γ)

N.H.Lazar, E.Eichler, G.D.O'Kelley, Phys. Rev. 101, 727 (1956).

Co^{58} 27 31 72^{d} g.s.

$\gamma(Fe^{58})$ 0.805 — $Ni^{(58)}$(fast n,p)
$\beta^{+}/0.805\gamma = 0.130$ *13* — scin $\gamma^{\pm}/\gamma$
(K x ray)(0.805γ) — pc, scin
No 0.50γ

M.A.Grace, G.A.Jones, J.O.Newton, Phil. Mag. 1, 363 (1956).

Co^{60} 27 33

ground state
J 5 — Co^{59}(pile n,γ); para
$|\mu|$ 3.800 *7*

W.Dobrowolski, R.V.Jones, C.D.Jeffries, Phys. Rev. 101, 1001 (1956).

Co^{60} 27 33 5.2^{y} g.s.

β^{-} 0.01%* 1.478 *6* $\Delta J = 3$, no shape — sl
*Assuming $\alpha = 1.32\times10^{-4}$ for 1.33γ

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

Co^{61} 27 34 1.7^{h}

τ 1.66^{h} *1*
β^{-} 95 ± 15% 1.220 *40* — scin
No γ with $0.40 < E_\gamma < 0.66$ ($< 0.5\%$)

R.H.Nussbaum, A.H.Wapstra, W.A.Bruil, M.J. Sterk, G.J.Nijgh, N.Grobben, Phys. Rev. 101, 905 (1956).

Ni^{58} 28 30

γ — $Ni^{58}(n,n'\gamma)$ — $E_n = 4.4$ scin

33†	1.01 *1*		
100†	1.46 *2*		

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

Ni^{59} 28 31 7.5×10^{4y}

$\tau_{\epsilon K}$ 10.0×10^{4y} *25* — Ni^{58}(pile n,γ)
γ continuum has forbidden shape — scin
τ from specific K x ray activity

B.Saraf, Phys. Rev. 102, 466 (1956).

Ni^{59} 28 31

Capture γ's — $Ni^{(58)}$(th n,γ) — scin Cp

8†	0.45 *3*		
3†	0.86 *3*	3†	2.06 *3*
2†	1.24 *3*	2†	2.68 *3*

Study covered $E_\gamma = 0.3$ to 3
†Photon /100 Ni captures, (±20%) ($\sigma_a = 4.5$)
(Max in $Ni^{59}, Ni^{61}, Ni^{62}, Ni^{63}, Ni^{65}$ = 71, 15, 0.6, 13, 0.5†)

T.H.Braid, Phys. Rev. 102, 1109 (1956).

Ni^{66} 28 38 55^{h}

τ 54.8^{h} *3* — U(170-Mev p,f) chem
β^{-} ~0.15 — a

A.Kjelberg, A.C.Pappas, Nuclear Phys. 1, 322 (1956).

Cu^{61} 29 32 3.3^{h}

β^{+}

3†	0.560			sl
5†	0.940			
~2†	1.150			scin $\beta\gamma$
51†	1.220 *15*			sl

$\gamma(Ni^{61})$

4†	0.070 *1*	11†	0.660 *10*	scin
12†	0.280 *3*	1.5†	0.940 *50*	
2.5†	0.380 *10*	1†	1.150 *50*	
1.5†	0.580 *20*	5†	1.220 *50*	

K.H.Nussbaum, A.H.Wapstra, W.A.Bruil, M.J. Sterk, G.J.Nijgh, N.Grobben, Phys. Rev. 101, 903 (1956).

Cu^{63} 29 34

Levels — $Cu^{63}(n,n'\gamma)$ — $E_n = 4.4$
γ

40†	0.63 *1*	60†	1.34 *3*	scin
100†	0.97 *1*	20†	1.43 *5*	

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Cu^{(63)}(\gamma,n)$ E_γ = 17.57 to 17.83
Dip in activation curve found for $E_\gamma \sim 17.72$

J.G.Campbell, Australian J. Phys. 8, 449 (1955).

Cu^{65} 29 36

Level — $Cu^{65}(n,n'\gamma)$ — $E_n = 4.4$
γ

90†	1.12 *2*			scin

†Photons/100 0.97γ's from $Cu^{63}(n,n'\gamma)$

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

Zn 30

Capture γ's — Zn(th n,γ) — scin Cp

11†	1.07 *3*	12†	1.77 *3*	
7†	1.26 *3*	10†	2.02 *3*	

Study covered $E_\gamma = 0.3$ to 3
†Photons/100 Zn captures, (±20%) ($\sigma_a = 1.09$)
(Max in Zn^{65}, Zn^{67} + Zn^{68}, Zn^{69}, Zn^{71} = 22, 62, 16, 0.05†)

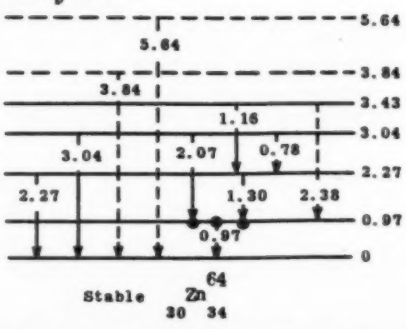
T.H.Braid, Phys. Rev. 102, 1109 (1956).

Zn^{64} 30 34

Capture γ's — Cu^{63}(p,γ) — E_p = 2 scin

32†	0.78 *2*	40†	2.27 *5*	
100†	0.97 *1*		2.38 *5*?	
17†	1.16 *3*		3.04 *5*	
29†	1.30 *3*		3.84 *5*?	
41†	2.07 *4*		5.64 *5*?	

Other γ's with $5.6 < E_\gamma < 10$
$(0.97\gamma)(0.78, 1.16, 1.30, 2.07, 2.38\gamma)$*
No $(0.97\gamma)(2.27\gamma)$*
*With $E_p = 2.5$



C.E.Weller, J.C.Grosskreutz, Phys. Rev. 102, 1149 (1956); 99, 655A (1955).

Nb^{97} 41 56 74^{m} g.s.

$\gamma(Mo^{97})$ d 17^{h} Zr chem

	100†	0.66 *1*	scin
	1†	1.02 *3*	

R. Nordhagen, J. Thomassen, Nuclear Phys. 1, 499 (1956).

Mo? 42

γ Mo(γ,?γ) $E_\gamma \leq 22$; scin

0.096 *5** $\gamma\gamma$ delay = $16.5^{\mu s}$ *12*

*Threshold = 8.4 ± 0.6

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

Mo 42

Resonances Mo(n) chopper

E_o(ev)	Γ_n(mev)*	Isotope
45 *0.5*	188 *30*	96
72 *1*	24 *6*	98
134 2.5	170 *55*	97

Resonances also observed at 162, 189, 283, 350, 400, 483, 715, 842 ev

*Assuming Γ_γ = 260 mev

J. A. Radkevich, V. V. Vladimirsky, V. V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Ru 44

Relative isotopic abundances ms

Ru^{96}	5.57% *8*		
Ru^{98}	1.86% 4	Ru^{101}	17.1% *1*
Ru^{99}	12.7% *1*	Ru^{102}	31.6% *2*
Ru^{100}	12.6% *1*	Ru^{104}	18.3% *1*

No Ru^{94}, Ru^{95}, Ru^{97} (<0.010%)

No Ru^{103} (<0.0001%) No Ru^{105} (<0.0007%)

No Ru^{106} (<0.0010%)

F. A. White, T. L. Collins, F. M. Rourke, Phys. Rev. 101, 1786 (1956).

Ru^{95} 44 51 1.6^{h}

τ		1.65^{h} *5*	$Ru^{(96)}$(n,2n) chem		
β^+	1†	1.2 *1*			a
$\gamma(Tc^{95})$					
	~1†	0.145	0.5†	0.640 *8*	scin
	4†	0.340 *8*	1†	1.110 *20*	

E. Schalscha, Nuclear Phys. 1, 481 (1956).

Pd? 46

γ Pd(γ,?γ) $E_\gamma \leq 22$; scin

0.165 *15* } $\gamma\gamma$ delay = $33^{\mu s}$ *6*

0.305 *15*

S. H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

Pd 46

Resonances Pd(n) chopper

E_o(ev)	$g\Gamma_n$(mev)	Γ_γ(mev)
11.68 *12*	0.030 *3*	220 *63*
13.65 *13*	0.23 *4*	241 *73*
24.8 *2*	0.278 *200*	292 *200*
32.5 *5*	13.7 *39*	180 *52*
55 *1*	0.85 *30*	
77.8 *20*	0.50 *16*	
89.5 *24*	95	
148 *5*	2.66 *70*	
183 *7*	8.8 *19*	
283 *15*	50 *15*	
355 *20*	12.8 *77*	
427 *27*	43 *10*	
891 *80*		

J. A. Radkevich, V. V. Vladimirsky, V. V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Ag 47

Resonances Ag(n,γ) pulsed n's

E_o(ev)	Γ_n^o*	E_o(ev)	Γ_n^o	E_o(ev)	Γ_n^o*
16.3	1.56	51.6	5.2	139.0	0.38
30.5	2.8	55.9	2.9	143.5	1.1
40.5	2.4	71.2	5.7	172.4	7
41.6	2.4	88.0	1.1	201.4	2.0
45	0.25	133.4	11	208	2.8
*Assuming g = 1/2; abundance 50%				251	13

Resonances also observed at 259, 264, 272, 290, 300, 310, 316, 326, 360, 386, 396, 403, 427, 443, 459, 466, 486, 499, 513, 523, 554, 563, 575, 586 ev *mev

See also Ag^{108}, Ag^{110}

J. Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Ag^{108} 47 61

Resonances $Ag^{(107)}$(n; n,γ) pulsed n's

E_o(ev)	J	Γ_γ(mev)	Γ_n(mev)
16.3	0	138	12
42	1	137 *19*	5.0 4
45		~200	
51.8	1	136 *16*	20.8 *9*

E. R. Rae, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Resonances $Ag^{(107)}$(n; n,γ) pulsed n's

E_o(ev)	$\sigma_o\Gamma$	Γ(mev)	$g\Gamma_n$(mev)
16.3	250	120	3.2
41.6	240	~500	7.8
45.0	24	160	0.9
51.6	470	130	19

For unassigned Ag resonances, see Ag

J. Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); G. Grimm et al., Phys. Rev. 98, 1161A (1955); W. W. Havens et al., Bull. Am. Phys. Soc. 1, No. 4, 177 F15 (1956); verbal report.

Ag^{110} 47 63

Resonances $Ag^{(109)}(n;\ n,\gamma)$ pulsed n's

E_o(ev)	J	Γ_γ(mev)	Γ_n(mev)
5.22	1	158 *11*	12.1 *9*
30.7	1	142 *13*	6.7 *5*
41	1	137 *19*	5.0 *4*
56	0	144 *11*	36.3 *14*
71	1	162 *6*	27.8 *7*
88	0	140 *21*	18.8 *14*

E.R.Rae, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Resonance $Ag^{(109)}(n)$

(5.2 ev) $\Gamma_\gamma = 136$ *6* mev

R.E.Wood, quoted by H.H.Landon, Phys. Rev. 100, 1414 (1955).

Resonances $Ag^{(109)}(n;\ n,\gamma)$ pulsed n's

E_o(ev)	$\sigma_o\Gamma$	Γ(mev)	$g\Gamma_n$(mev)
30.5	250	120	7.8
40.5	249	~50	7.7
55.9			11
71.2			24
88.0			5.2

For unassigned Ag resonances, see Ag

J.Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); G. Grimm et al., Phys. Rev. 98, 1161A (1955); W. W.Havens et al., Bull. Am. Phys. Soc. 1, No.4, 177 F15 (1956); verbal report.

Cd 48

Resonances Cd(n) chopper

E_o(ev)	E_o(ev)
18.0	66.6
27.2*	88.2§

Assigned to *Cd^{112}, §Cd^{111} q.v.

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Cd^{111} 48 63

Resonance $Cd^{110}(n)$ chopper

88.2 ev $\Gamma \sim 0.34$ ev $\sigma_o = 19000$

$\Gamma_n \sim 0.23$ ev

Assumed $\Gamma_\gamma = 0.12$ ev

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Cd^{112} 48 64

Resonance $Cd^{111}(n)$ chopper

27.2 ev $\Gamma = 0.130$ $\Gamma_n = 0.010$ $\sigma_o = 2400$ for $g = 1/4$

$\Gamma = 0.123$ $\Gamma_n = 0.003$ $\sigma_o = 2600$ for $g = 3/4$

Assumed $\Gamma_\gamma = 0.12$ ev

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Cd^{114} 48 66

Capture γ's $Cd^{(113)}(n,\gamma)$ scin Cp

100†	0.56 *2*	15†	2.53 *3**
13†	1.32*	9†	3.27 *3**

*Two or more unresolved γ's

T.H.Braid, Phys. Rev. 102, 1109 (1956).

In 49

Relative isotopic abundances ms

In^{113} 4.33% *4*

In^{115} 95.67%

No In^{108}, In^{109}, In^{110}, In^{111} ($< 2 \times 10^{-6}$%)

No In^{112} ($< 4 \times 10^{-6}$%)

No In^{114} ($< 2 \times 10^{-5}$%)

No In^{116} ($< 1 \times 10^{-5}$%)

No In^{117}, In^{118} ($< 8 \times 10^{-6}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

In^{111} 49 62 2.8^d

$\gamma(Cd^{111})$ (0.172) E2/M1 = 0.016 $\gamma\gamma(\theta)$

(0.247) E2 = 100%

(0.172 γ)(0.247 γ)(θ) J = 7/2, 5/2, 1/2

$\gamma\gamma(\theta)$, $ce_K\gamma(\theta)$, $\gamma ce_K(\theta)$, $ce_K ce_K(\theta)$

P.Gimmi, E.Heer, P.Scherrer, Helv. Phys. Acta, 29, 147 (1956); 27, 180A (1954); Z. Phys. 138, 394 (1954).

In^{114} 49 65 72^s g.s.

$50^d In^{114}$ source scin $\beta\gamma$

β^- 0.2% 0.71 *5*

$\gamma(Cd^{114})$ (0.556)

$\gamma(Sn^{114})$

0.2% 1.299 *2* sd pe

(0.71β)(1.299γ) No (0.556γ)(1.299γ) scin

No 0.576γ (< 0.03%) No 1.271γ (< 0.01%)

M.W.Johns, I.R.Williams, D.E.Brodie, Can. J. Phys. 34, 147 (1956).

In^{114} 49 65

Resonances $In^{(113)}(n)$ chopper

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
14.67 *23*	7.5 *8*	25.0 *5*	10.0 *15*
19.7 *3*		32.3 *7*	10.2 *22*
21.4 *4*	2.5 *6*	70.0 *24*	29 *10*

*Assuming $\bar{\Gamma} = 80$ mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

In^{116} 49 67 54^m

$\gamma(Sn^{116})$ $In^{(115)}$(slow n,γ) scin

0.137			
0.40	E2/M1 = 24		
0.80	E2/M1 = 9		
1.09	E2	1.48	E2
1.27	E2	2.09	E2

(1.09 γ)(1.27 γ)(θ) J = 4, 2, 0

(1.48 γ)(1.27 γ)(θ) J = 4, 2, 0

(0.80 γ)(1.27 γ)(θ) J = 2, 2, 0

(0.40 γ)(2.09 γ)(θ) J = 2, 2, 0

R.P.Scharenberg, M.G.Stewart, M.L.Wiedenbeck, Phys. Rev. 101, 689 (1956).

$In^{116}_{49\ 67}$

Resonances $In^{(115)}(n)$ chopper

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
9.00 *11*	1.74 *43*		
12.0 *2*	0.116 *10*	63 *2*	
22.8 *4*	1.35 *19*	84.2 *30*	13.2 *45*
39.8 *10*	4.1 *8*	95 *4*	2.2 *9*
47.9 *13*	0.98 *30*	129 *6*	

*Assuming Γ_γ = 80 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Sn^{113}_{50\ 63}$ $^{115^d}$

τ 130^d *3* Sn^{112}(pile n,γ)

$\gamma(In^{113})$

12†	0.258	scin
100†	0.393	

G.Gardner, J.I.Hopkins, Phys. Rev. 101, 999 (1956).

$Sn^{117}_{50\ 67}$ $^{14^d}$

Sn^{116}(pile n,γ)

γ (0.161) E2/M1 = 0.0015 (+*15*,−*10*) (ce_K 0.159 $\gamma\gamma$(0.161 $\gamma\gamma(\theta)$; sl, scin

R.K.Golden, S.Frankel, Phys. Rev. 102, 1053 (1956); 95, 613A (1954).

$Sb^{116}_{51\ 65}$ $^{15.8^m}$

β^+ 2.3 *3* a

A.H.W.Aten, Jr., Physica 22, 288 (1956); 20, 665 (1954).

$Sb^{122}_{51\ 71}$

Resonances Sb^{121}(n) chopper

$\sigma_o(10^3 b)$	E_o(ev)	Γ(mev)	Γ_n(mev)
10.8	6.25	62	3.2
11.9	15.6	70	10.0
5.2	29.8	68	8.2
1.4	53.5	64	3.7
0.36	64.0	61	1.1
2.9	74.0	72	11.9
5.8	90	102	41

For 6.25 ev resonance, Γ_γ = 60 ± 20 mev
For other resonances Γ_γ = 60 mev was assumed
Values assuming Γ_γ = 100 mev are also given

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Sb^{124}_{51\ 73}$

Resonances Sb^{123}(n) chopper

$\sigma_o(10^3 b)$	E_o(ev)	Γ(mev)	Γ_n(mev)
21.00	21.6	92	32
2.48	50.5	66	6.5
4.35	76.5	80	20
6.70	105	131	71

Assuming Γ_γ = 60 mev
Values assuming Γ_γ = 100 mev are also given

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

$Sb^{125}_{51\ 74}$ $^{2.0^y}$

$Sn^{(124)}$(pile n,$\gamma\beta$) chem

τ 2.0^y *2*

$\gamma(Te^{125})$

1.4†	0.113			scin γ
19†	0.175			
0.6†	0.175			scin $\gamma\gamma$
0.8†	0.205			
0.6†	0.214			
0.88†	0.320			
3.8†	0.377			scin γ
100†	0.427	88†	0.595	
31†	0.463	23†	0.637	

(K x ray)(0.427, 0.595γ)
(0.133 $\gamma\gamma$(0.2, 0.37 $\gamma\gamma$)
(0.175 $\gamma\gamma$(0.113, 0.205, 0.320 $\gamma\gamma$)
(0.427 $\gamma\gamma$(0.175, 0.214 $\gamma\gamma$)
(0.463 $\gamma\gamma$(0.175, 0.214 $\gamma\gamma$)
No 0.140, 0.342 γ

N.H.Lazar, Phys. Rev. 102, 1058 (1956).

$Sb^{127}_{51\ 76}$ $^{93^h}$

$Te^{(128)}(\gamma,p)$ chem; $E_\gamma \leq 70$

β^-	50%	0.86 *2*			scin
	20%	1.11 *3*			
	30%	1.57 *3*			
$\gamma(Te^{127})$		0.058 *10*	st	0.456 *4*	scin
		0.185 *8*		0.563 *5*	
	st	0.240 *3*	st	0.674 *5*	
		0.417 *8*		0.764 *10*	

(0.86 $\beta\gamma$(0.674 $\gamma\gamma$) (1.11 $\beta\gamma$(0.456 $\gamma\gamma$)

M.C.Day, Jr., A.F.Voigt, Phys. Rev. 101, 1784 (1956).

$Sb^{129}_{51\ 78}$ $^{4.6^h}$

$Te^{(130)}(\gamma,p)$ chem; $E_\gamma \leq 70$

β^-	20%	1.87 *5**			scin
$\gamma(Te^{129})$		0.165 *5*		0.534 *3*	scin
		0.308 *4*		0.788 *5*	

*Also other β^- groups with $E_\beta < 1.87$

M.C.Day, Jr., A.F.Voigt, Phys. Rev. 101, 1784 (1956).

$Te^{125}_{52\ 73}$

Te^{125}(n,n'γ) E_n = 4.4

No γ observed scin

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Te^{126}_{52\ 74}$

γ Te^{126}(n,n'γ) E_n = 4.4

60†	0.68 *2*		scin
20†	1.38 *4*		

No 0.74γ (< 0.03†)
†Photons /100 0.83γ's from Te^{130}(n,n'γ)

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$Te^{127}_{52\ 75}$ $^{9.3^h}$ e.s.

β^- 0.72 *5* F-K linear sm ppl

P.Kleinheins, Z. Naturf. 11a, 252 (1956).

Te^{128} 52 76

Level $Te^{128}(n,n'\gamma)$ $E_n = 4.4$
γ 70† 0.76 2 scin
†Photons/100 0.83γ's from $Te^{130}(n,n'\gamma)$

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

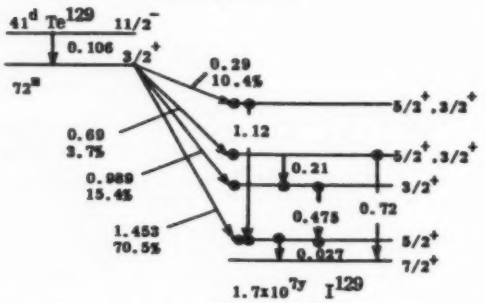
Te^{129} 52 77 72^m g.s.

τ 74^m Te^{128}(11.5-Mev d,p) chem
β^- 10% 0.29 6 15% 0.969 20 sl
4% 0.69 10 71% 1.453 5
$\gamma(I^{129})$ 0.0268 scin, sl ce
0.475 5 scin
~0.77
1.12 2
ce 0.0268γ/β~0.23 sl

W.E.Graves, A.C.G.Mitchell, Phys. Rev. 101, 701 (1956); 100, 1236A (1955).

Te^{129} 52 77 33^d+72^m

τ 41^d Te^{128}(11.5-Mev d,p) chem
β^- 13% 0.35 6 16% 0.972 20 sl
3% 0.66 10 68% 1.538 5
$\gamma(Te^{129})$ 0.1063 1 s ce
$\gamma(I^{129})$ 0.0268 scin,sl ce
0.21 1 0.72 1 scin
0.475 5 1.14 2
(0.35β)(1.14γ) (0.66β)(0.72γ) scin
(0.97β)(0.475γ) (1.5β)(0.027γ)*
(0.027γ)(0.475, 1.14γ) (0.21γ)(0.475γ)
Ce 0.106γ/β = 0.95 sl
*F-K end point gave E_β = 1.45



W.E.Graves, A.C.G.Mitchell, Phys. Rev. 101, 701 (1956); 100, 1236A (1955).

Te^{130} 52 78

Level $Te^{130}(n,n'\gamma)$ $E_n = 4.4$
γ st 0.83 scin

R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42, K3 (1956).

Te^{132} 52 80 78^h

τ 75^h 3 U(n,f), Pu(n,f)
Xe^{132}/Xe^{134} as f(t),ms

W.H.Fleming, H.G.Thode, Can. J.Chem. 34, 408 (1956).

I 53

Relative isotopic abundance
No I^{129} (<10^{-6}%) from absence of $12.5^h I^{130}$ after neutron irradiation of iodine

B.C.Purkayastha, G.R.Martin, Can. J. Chem. 34, 293 (1956).

I^{128} 53 75 25^m

I^{127}(slow n,γ) chem
β^- 2.0% 1.125 20 1.665β - 0.540γ,sl
15.5% 1.665 15 sl
76.0% 2.120 10
No β^+ sl,scin
$\gamma(Te^{128})$
0.31% 0.750 7 scin
$\gamma(Xe^{128})$
17.2% 0.455 5 scin
1.8% 0.540 5 0.29% 0.990 10
$\beta^-/0.455\gamma$ = 5.0 ± 0.5 sl,scin
$\epsilon_K/0.455\gamma$ = 0.316 Te K x ray/0.455γ pc,scin
Total ϵ decay is 6.4% assuming ϵ_L/ϵ_K = 0.1
(0.455γ)(0.540γ) scin
(0.750γ)(Te x rays)

N.Benczer, B.Farrelly, L.Koerts, C.S.Wu, Phys. Rev. 101, 1027 (1956); 100, 955A (1955).

I^{128} 53 75

Resonances I^{127}(n) chopper

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
20.5 4	1.08 24		
31.4 6	15 3	66 2	14.5 65
38.1 9	36 7	79 3	37 16
46.0 12	21 6	92 4	21 11

*Assuming Γ_γ = 100 mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

I^{131} 53 78 8.05^d

$\gamma(Xe^{131})$ 0.08016 L_1/L_2~10 s?? ce
0.1638 1
0.1771 1

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 748 (1956).

Cs 55

Relative isotopic abundances ms
Cs^{133} 100.0%
No Cs^{130} (< 2 x 10^{-6}%) No Cs^{134} (< 5 x 10^{-5}%)
No Cs^{131}, Cs^{136} (< 1 x 10^{-5}%)
No Cs^{132}, Cs^{135} (< 3 x 10^{-5}%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Cs^{134} 55 79 2.3^y g.s.

No 1.451β^- (<5x10^{-3}%) sl

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

$\gamma(Ba^{134})$

	α	
(0.569)	0.0092 12	sl ce,Cp
(0.605)	0.0053 5	
(0.796)	0.0024 3	
(1.367)	0.00049 5	

Z.O'Friel, A.H.Weber, Phys. Rev. 101, 1076 (1956).

Cs^{138} 55 83 32^m

τ 32.2^m 1 $U^{(235)}$(n,f) chem

R.H.Bartholomew, A.P.Berg, Can. J.Chem. 34, 201 (1956).

Ba^{131} 56 75 11.5^d

τ 11.52^d *8* $Ba^{(130)}(n,\gamma)$ chem

$\gamma(Cs^{131})$	0.083*	360†	0.496*	scin
200†	0.122	33†	0.620	
150†	0.214	2†	0.823 *20*	
	0.244 ?	7†	0.917 *15*	
100†	0.372	11†	1.032 *15*	

(0.496 γ)(0.122 γ) Σ scin

No 0.100, 0.196, 0.585 γ's

0.823, 0.917, 1.032 γ's are not crossovers

*Two or more unresolved γ's

W.C.Bogge, B.L.Robinson, R.W.Fink, Phys. Rev. 101, 149 (1956).

Ba^{135} 56 79

ground state enriched Ba^{135}

μ +0.832293 *25* I

$\nu(Ba^{135})/\nu(Cl^{35})$ = 1.01387 *2*

H.E.Walchli, T.J.Rowland, Phys. Rev. 102, 1334 (1956).

Ba^{137} 56 81

ground state enriched Ba^{137}

μ +0.931074 *55* I

$\nu(Ba^{137})/\nu(Cl^{35})$ = 1.13420 *5*

H.E.Walchli, T.J.Rowland, Phys. Rev. 102, 1334 (1956).

Ba^{140} 56 84 13^d

$\gamma(La^{140})$	(0.030)	0.304	scin
	~0.132	0.436	
	0.162	0.537	

(0.030 γ)(0.436 γ) (0.304 γ)(0.162 γ) Σ scin

(~0.132 γ)(0.304 γ) No γ(0.537 γ)

(0.304 γ)(0.162 γ)(θ) consistent with J = 1,3,4

$W(\theta) = 1 + (0.0937\ 8)P_2(\cos\theta) - (0.056\ 10)\ P_4(\cos\theta)$

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

La 57

Relative isotopic aoundances ms

La^{138} 0.089% *1.5*

La^{139} 99.911% *1.5*

No La^{134}, La^{135}, La^{136} ($< 7 \times 10^{-6}$%)

No La^{137} ($< 14 \times 10^{-6}$%) No La^{140} (< 0.001%)

No La^{141} (< 0.002%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

La^{138} 57 81 2×10^{11}y

τ_{ϵ_K} 3.2×10^{11}y *7* natural La chem; pc

0.23 K x rays/sec g La

$\epsilon_L/\epsilon_K \leq 0.5$ (L x rays not observed)

H.Selig, Thesis, Carnegie Inst. Tech. (1954); NYO-6626 (1954).

La^{139} 57 82

ground state

q +0.3 *1* S

G.Lühr, Z. Phys. 191, 486 (1955).

La^{140} 57 83 40^h

(0.328 γ)(1.60 γ)(θ) scin

(0.328 γ)(0.49 γ)(θ)

(0.815 γ)(1.60 γ)(θ)

(0.490 γ)(1.60 γ)(θ)

Consistent with J = 3, 4, 2, 0 for Ce^{140} levels at 2.42, 2.09, 1.60, g.s.

W.H.Kelly, M.L.Wiedenbeck, Phys. Rev. 102, 1130 (1956).

Ce^{141} 58 83 33^d

Ce^{140}(pile n,γ)

$\gamma(Pr^{141})$ 0.1416 *3* sd ce

D.W.Martin, M.K.Brice, J.M.Cork, S.B.Burson, Phys. Rev. 101, 182 (1956).

Pr^{141} 59 82

ground state

μ +4.0 *1* S

q 0.0 *2*

K.Murakawa, J.Phys. Soc. Japan 9, 93 (1954).

Nd 60

Relative isotopic abundances ms

Nd^{142}	27.3% *2*		
Nd^{143}	12.32% *9*	Nd^{146}	17.10% *14*
Nd^{144}	23.8% *1.8*	Nd^{148}	5.67% *5*
Nd^{145}	8.29% *6*	Nd^{150}	5.56% *5*

No Nd^{139} ($< 3 \times 10^{-4}$%)

No Nd^{147}, Nd^{152} ($< 2 \times 10^{-4}$%)

No Nd^{140}, Nd^{149}, Nd^{151}, Nd^{153} ($< 1 \times 10^{-4}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Nd^{144} 60 84 5×10^{15}y

τ 5×10^{15}y 2.5 enriched Nd^{144} ppl

α 1.8 *1* ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956); 9a, 701 (1954).

Sm^{147} 52 85

ground state

|μ| 0.83 *15* para

|q| < 0.72

Calculated from data of G.S.Bogle, H.E.D. Scovil, Proc. Phys. Soc. 65A, 368 (1952).

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

Sm^{149} 62 87

ground state

|μ| 0.68 *10* para

|q| < 0.72

Calculated from data of G.S.Bogle, H.E.D. Scovil, Proc. Phys. Soc. 65A, 368 (1952)

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

Gd 64

No α's $\tau > 4 \times 10^{16}$y for $1.5 < E_\alpha < 2.5$; pp

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

Gd^{153} 64 89 236^{d}

$\gamma(Eu^{153})$ $Gd^{(152)}$(pile n,γ)

	5†	0.069	K/L > 4.5 scin, s ce
	~28†	0.098 5	$\alpha_K = 0.3^{*}$ 1 E1
	~27†	0.103	K/L = 6
x	100†	K x ray	

$(ce_K\ 0.098\gamma)/(ce_K\ 0.103\gamma) = 0.25$ 5
No $(0.098\gamma)(0.103\gamma)$ No β^{+}
Authors conclude $\epsilon_L/\epsilon_K > 1$, $E_{dis} \sim 0.22$
*Assuming $\alpha_K = 1.2$ for 0.103γ

N.Marty, M.Vergnes, Compt. rend. 242, 1438 (1956).

$\gamma(Eu^{153})$ source not described

	7†	0.072 8	scin
	100†	0.100 4	$\alpha_K = 0.67$ 12 $x\gamma/\gamma$, xx/x
x	160†	K x ray	x/γ

(K x ray)(K x ray, 0.072?, 0.100γ)
No other γ
Authors conclude $\epsilon_L/\epsilon_K \sim 0.42$, $E_{dis} \sim 0.20$
$E_{dis} = 0.225^{*}$ Σ scin

S.K.Bhattacherjee, S.Raman, Nuclear Phys. 1, 486 (1956); *R.K.Gupta, S.Jha, ibid.

Gd^{155} 64 91

	ground state	enriched Gd^{155}; S
J	3/2*	
μ	−0.30	
q	+1.1 3	

*Value consistent with theory for deformed nuclei[$], not with shell model prediction

D.R.Speck, Phys. Rev. 101, 1725 (1956); 100, 973A (1955); [$]B.R.Mottleson, S.G.Nilsson Phys. Rev. 99, 1615 (1955).

Levels $Gd^{155}(\alpha,\alpha'\gamma)$ $E_\alpha = 1.75$
$Gd^{155}(p,p'\gamma)$ $E_p = 1.75$

γ	0.060 1	$\epsilon B(E2) = 0.48$ sd ce_L
	0.146 2	$\epsilon B(E2) = 0.06$ sd ce_K

J.H.Bjerregaard, U.Meyer-Berkhout, Z. Naturf. 11a, 273 (1956).

Level $Gd^{155}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
γ 0.145 1 $\epsilon B(E2) = 0.105$ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Level $Gd^{155}(p,p'\gamma)$ $E_p = 2.9$
γ 0.140 14 scin

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Gd^{156} 64 92

Resonance $Gd^{(155)}$(n)
2.01 ev $\Gamma_\gamma = 104$ 5 mev

E.T.Florance, V.L.Sailor, quoted by H.H. Landon, Phys. Rev. 100, 1414 (1955).

Gd^{157} 64 93

	ground state	enriched Gd^{158}; S
J	3/2*	
μ	−0.37 4	
q	+1.0 3	

*Value consistent with theory for deformed nuclei[$], not with shell model prediction

D.R.Speck, Phys. Rev. 101, 1725 (1956); 100, 973A (1955); [$]B.R.Mottleson, S.G.Nilsson Phys. Rev. 99, 1615 (1955).

Levels $Gd^{157}(\alpha,\alpha'\gamma)$ $E_\alpha = 1.75$
$Gd^{157}(p,p'\gamma)$ $E_p = 1.75$

γ	0.055 1	$\epsilon B(E2) = 0.54$ sd ce_L
	0.132 2	$\epsilon B(E2) = 0.03$

J.H.Bjerregaard, U.Meyer-Berkhout, Z. Naturf. 11a, 273 (1956).

Level $Gd^{157}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
γ 0.131 1 $\epsilon B(E2) = 0.086$ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 100, 150; 98, 1198A (1955); priv. comm.

Level $Gd^{157}(p,p'\gamma)$ $E_p = 2.9$
γ 0.127 13 scin

H.Mark, G.T.Paulissen, Phys. Rev. 100, 813 (1955).

Gd^{158} 64 94

Resonance $Gd^{(157)}$(n)
2.82 ev $\Gamma_\gamma = 114$ 5 mev

E.T.Florance, V.L.Sailor, quoted by H.H. Landon, Phys. Rev. 100, 1414 (1955).

Tb^{161} 65 96 6.8^{d}

τ 6.9^{d} 1 $Gd^{(160)}$(pile n,$\gamma\beta$)
β^{-} ~1000† 0.300 3 F-K linear $E_\beta > 0.10$ sl
$\gamma(Dy^{161})$

	100†	0.0259 2	scin, pc
	31†*	0.049 2	$\alpha \sim 1.5$ $\gamma\gamma/\gamma$
	57†	0.077 2	$\alpha_K < 3.5$[$]
x	150†*	K x ray	

$(E_\beta > 0.20)(0.0259, 0.049, 0.077\gamma)$ scin
$(0.049\gamma)(0.0259\gamma)$ No $\gamma(0.077\gamma)$
No $\beta(0.106\gamma)$. γ observed but assigned to Gd^{153}
*Assuming $\alpha_K = 2.9$ for 0.077γ
[$]From $(0.049\gamma + K\ x\ ray)/(0.077\gamma) = 3.2$

A.Bisi, S.Terrani, L.Zappa, Nuclear Phys. 1, 425 (1956).

Er^{167} 68 99

	ground state	
$\lvert\mu\rvert$	0.50 12	para
$\lvert q\rvert$	10 2	

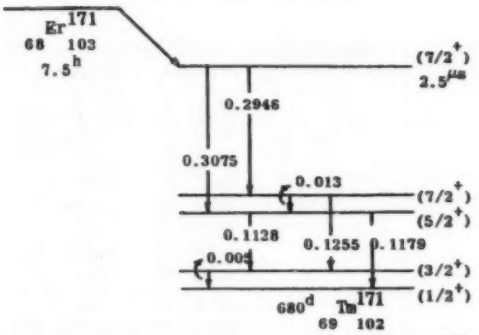
Recalculated from data of G.S.Bogle et al., Proc. Phys. Soc. 65A, 760 (1952)

R.J.Elliott, K.W.H.Stevens, Proc. Roy. Soc. 219, 387 (1953).

Er^{171} 68 103 7.5^h — $\gamma(Tm^{171})$ — $Er^{(170)}$(slow n,γ); scin

0.115	(0.1128, 0.1179, 0.1255)*	
0.300	(0.2946, 0.3975)*	

β(0.115, 0.300 γ) delay
(0.115 $\gamma\gamma$(0.300 γ) No (0.115 $\gamma\gamma$(0.115 γ)
No 0.176, 0.420 γ (< 1% of 0.300 γ)



Level scheme proposed in analogy to that of Tm^{169}

S.D.Koički, A.M.Koički, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 1 (1956); *H.B.Keller, J.K.Cork, Phys. Rev. 84, 1079 (1951).

Tm^{170} 69 101 127^d — $\gamma(Yb^{170})$ — Tm^{169}(pile n,γ)

	107†	0.084229 41	cryst
x	191†	Yb K x ray	
	6.4†	Er K x ray*	

No other γ with $0.070 < E_\gamma < 0.083$, or $0.085 < E_\gamma < 0.090$ (< 2†)
*Not due to $87^d Tm^{168}$ (no 0.65 γ) scin

P.P.Day, Phys. Rev. 102, 1572 (1956).

Tm^{170} 69 101 — $\gamma(Yb^{170})$ (0.084) — Tm^{169}(pile n,γ) chem
K:L:M:N = 100:314:72:9.6 sd ce

P.R.Gray, Phys. Rev. 101, 1306 (1956).

Yb^{169} 70 99 31^d — τ 30.6^d 2 — $Yb^{(168)}$(pile n,γ)
$\gamma(Tm^{169})$

0.0084		s77 ce
0.0206	K : L_1 : L_2 : L_3	
0.0632	100 : 43 : 55	
0.0936	210 : 100 : 18 : 10	
0.1099	360 : 100 : 19 : 6	
0.1183	9 : 10	E2
0.1307	150 : 100 : 90	
0.1777	56 : 10	
0.1986	66 : 10	
0.2610		
0.3083	35 : 10	

(0.178 $\gamma\gamma$(0.131 γ)) (0.261 $\gamma\gamma$(~0.115 γ))
No (0.261 $\gamma\gamma$(0.131, ~0.19, 0.308 γ))
Sum peaks at 0.115, 0.263, 0.317 Σ scin
No 0.143, 0.160 γ s77 ce

J.M.Cork, M.E.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100, 1237A (1955).

Yb^{169} 70 99 31^d — $\gamma(Tm^{169})$ — $Yb^{(168)}$(pile n,γ)

	0.063	178†	0.178	scin
	0.094	226†	0.198	
157†	0.110	20†	0.260	
96†	0.132	95†	0.308	

(0.110 $\gamma\gamma$(0.178?*, 0.198 γ))
(0.132 $\gamma\gamma$(0.178 γ))
Only 0.063 and 0.094 γ precede 0.7$^{\mu s}$ level $\gamma\gamma$ delay
No ϵ to 0.120 or 0.142 level xγ delay
(K x ray)(0.063, 0.094, 0.260 γ) delay < 0.3$^{\mu s}$
*(0.110 $\gamma\gamma$(0.178 γ)) < 0.1 of (0.132 $\gamma\gamma$(0.178 γ))

S.D.Koički, A.M.Koički, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 1 (1956).

Yb^{169} 70 99 — Resonance — $Yb^{(168)}$(n)
0.597 ev Γ_γ = 70 5 mev

V.L.Sailor, H.H.Landon, H.L.Foote, Jr., quoted by H.H.Landon, Phys. Rev. 100, 1414 (1955).

Yb^{175} 70 105 4.2^d — τ 4.2^d 1 — $Yb^{(174)}$(pile n,γ)

β^-	~25†	0.374 30		sd
	100†	0.471 3		
$\gamma(Lu^{175})$		0.1141	K/L = 2.9 4	s77 ce
		$L_1:L_2:L_3$ = 100:41:27		M1,E2
		0.1378	K/L ~2	
		0.1450		
		0.2829	K/L_2 ~6	
		0.3970	K/L = 5.4 3	

J.M.Cork, M.E.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100, 1237A (1955).

Yb^{177} 70 107 1.8^h — τ 1.88^h 10 — $Yb^{(176)}$(pile n,γ)
$\gamma(Lu^{177})$

~25†	0.119	scin $\beta\gamma$
100†	0.148	scin
~ 5†	1.080 5	
~ 5†	1.228 5	

(E_β > 0.5)(0.119 γ) scin
(1.080 $\gamma\gamma$(0.148 γ)) No (1.228 $\gamma\gamma$(0.148 γ))
Not p 6.8$^d Lu^{177}$ (expected decay, ce, and β not observed)

J.M.Cork, M.E.Brice, D.W.Martin, L.C.Schmid, R.G.Helmer, Phys. Rev. 101, 1042 (1956); 100 1237A (1955); priv. comm. 1955.

Hf 72 — Relative isotopic abundances — ms

Hf^{174}	0.163% 2	Hf^{178}	27.10% 1
Hf^{176}	5.21% 2	Hf^{179}	13.75% 5
Hf^{177}	18.56% 6	Hf^{180}	35.22% 1

No Hf^{172}, Hf^{173}, Hf^{185} ($< 2 \times 10^{-5}$%)
No Hf^{175}, Hf^{182}, Hf^{183}, Hf^{184} ($< 5 \times 10^{-5}$%)
No Hf^{181} ($< 3 \times 10^{-5}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956).

Hf^{177} 72 105

	ground state	enriched Hf^{177}
J	7/2	S
μ	+0.61 *3*	
q	+3 *1*	

$q(Hf^{177})/q(Hf^{179}) = 0.99$ *2*

D.R.Speck, F.A.Jenkins, Phys. Rev. 101, 1831 (1956); Bull. Am. Phys. Soc. 1, No. 6, 282 C3 (1956).

Hf^{178} 72 106

Resonances $Hf^{(177)}(n)$ E_n = 0.5 to 7 ev

E_o(ev)	σ_o	Γ_γ^n(mev)	Γ_n(mev)
1.100 *5*	6500	67 *2*	2.10 *5*
2.39 *1*	1350	60 *1*	9.3 *2*

G.Igo, H.H.Landon, Phys. Rev. 101, 726 (1956).

$Hf^{(177)}(n)$

Resonances $\sigma_o(10^3b)$	E_o(ev)	Γ_γ(mev)	chopper Γ_n(mev)
	(2.38)	63 *8*	7 *1*
40 *20*	6.5 *1*	44 *20*	11 *2*

Assumed g = 1/2

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Hf^{179} 72 107

	ground state	enriched Hf^{179}
J	9/2	S
μ	−0.47 *3*	
q	+3 *1*	

$\mu(Hf^{177})/\mu(Hf^{179}) = -1.276$ *8*

$q(Hf^{177})/q(Hf^{179}) = 0.99$ *2*

D.R.Speck, F.A.Jenkins, Phys. Rev. 101, 1831 (1956); Bull. Am. Phys. Soc. 1, No. 6, 282 C3 (1956).

Ta 73

Relative isotopic abundances ms

Ta^{180} 0.0123% *3*

Ta^{181} 99.9877% *3*

No Ta^{177}, Ta^{178}, Ta^{179} ($< 3 \times 10^{-4}$%)

No Ta^{182}, Ta^{183} ($< 2 \times 10^{-4}$%)

F.A.White, T.L.Collins, F.M.Rourke, Phys. Rev. 101, 1786 (1956); 97, 566 (1955).

Ta^{181} 73 108

Level $Ta^{181}(\alpha,\alpha'\gamma)$ E_α = 3.0

γ (0.137) α_K = 1.05 *15* scin x/γ

P.H.Stelson, F.K.McGowan, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Ta^{182} 73 109 111^d

$\gamma(W^{182})$ $Ta^{(181)}$(pile n,γ)

100†	1.1216 *3*	4†	1.254	sd pe
	1.1894 *3*	3†	1.273	
	1.2220 *3*	~2†	1.289	

No 1.375, 1.437, 1.454γ (< 0.3†)

G.Bäckström, Arkiv Fysik 10, 387 (1956).

Ta^{182} 73 109

Resonance $Ta^{181}(n)$

4.28 ev Γ_γ ~ 49 *6* mev

R.E.Wood, quoted by H.H.Landon, Phys. Rev. 100, 1414 (1955).

$Ta^{181}(n)$

Resonances $\sigma_o(10^3b)$	E_o(ev)	Γ_n^o(mev)*	chopper Γ_γ(mev)
12 4	10.2 *1*	1.15 *19*	54 *10*
2.4 *8*	13.6 *1*	0.26 *3*	36 *8*
1.1 4	18.6 *2*	0.18 *2*	85 *20*
1.5 *7*	20.1 *2*	0.26 *4*	50 *15*
0.30 4	22.3 *3*	0.055 *7*	
16 *7*	23.7 *4*	1.8 *4*	21 *8*
	29.9 *5*	0.066 *15*	
	35.0 *6*	9.5 *3*	
	38.9 *7*	7.6 *6*	
	48 *10*	0.6 *1*	
	51.0 *5*	0.7 *1*	
	57.4 *6*	0.21 *10*	
	63.1 *15*	0.7 *3*	
	77 *1*	1.7 *9*	
	83 *2*	2.1 *4*	
	98 *2*	~10	
	105 *1.5*	8 *3*	
	114.9 *17*	9.1 *37*	
	126.5 *20*	7.2 *41*	
	135.5 *2.3*	4.9 *3*	
	173 *3*	7.4 *5*	
	197 *4*	6 *5*	
	211 *5*		
	297 *7*		

*Assuming g = 1/2

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

$Ta^{181}(n;\ n,\gamma)$ pulsed n's

Resonances E_o(ev)	Γ_n^{o*}	E_o(ev)	Γ_n^{o*}	E_o(ev)	Γ_n^{o*}
63.2	1.0	91.1	0.38	126.0	4.3
76.7	1.6	96.7	0.43	135.9	2.0
77.5	0.74	99.0	12	138.0	1.6
78.6	0.41	103.2	0.09	143.6	0.20
82.7	1.8	105.4	3.0	148.0	0.39
84.9	0.67	114.8	4.1	149.2	0.66
89.4	0.48	118.0	0.22	165.5	0.82
*Assuming g = 1/2; units: mev				175	14

Resonances also observed at 178, 181.5, 185, 188, 194.5, 199.4, 204, 207.9, 212, 214.5, 216.3, 219.5, 221, 224.5 ev

J.Rainwater, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

W 74

τ	2.2×10^{17}y	natural W; ppl
α	3.8 *2*	ppl

Activity not due to mass 178 or 179 ms

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

$Re^{185}_{75\ 110}$

Level	$Re^{185}(\alpha,\alpha'\gamma)$		$E_\alpha = 3.0$
γ	0.128	$\alpha_K = 2.10\ 43$	scin x/γ

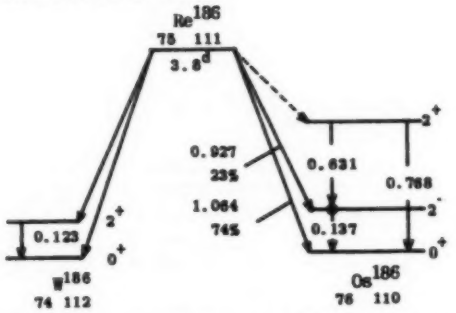
P.H.Stelson, F.K.McGowan, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Re^{186}_{75\ 111}$ 3.8^d

β^-	240†	0.927 2	$Re^{(185)}$(pile n,γ); sd
	760†	1.064 2	
ϵ_K	32†		
$\gamma(W^{186})$	6†	0.1229 4	K/L = 0.43 sd pe,ce
$\gamma(Os^{186})$			
	100†	0.1372 2	K:L:MN 47:76:14
		α_K = 0.45 from $(\beta x)/(\beta\gamma)$ = 0.43 3	
	0.2†	0.6308 8	sd pe
	0.2†	0.7682 10	
x	75†	K x rays	scin

(0.631 γ)(0.137 γ) No (0.768 γ)(0.137 γ) scin

β(0.137 γ) delay ~$0.9^{m\mu s}$



M.W.Johns, C.C.McMullen, I.R.Williams, S.V. Nablo, Can. J. Phys. 34, 69 (1956); Phys. Rev. 91, 418 (1953).

$Re^{187}_{75\ 112}$

Level	$Re^{187}(\alpha,\alpha'\gamma)$		$E_\alpha = 3.0$
γ	0.134	$\alpha_K = 1.50\ 29$	scin x/γ

P.H.Stelson, F.K.McGowan, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Re^{188}_{75\ 113}$ 17^h g.s.

β^-	~1%	<1.9	$Re^{(187)}$(pile n,γ); sd
	20%	1.961 2	
	79%	2.116 2	
$\gamma(Os^{188})$			sd pe,ce
	9000†	0.1550 2	α_K = 0.40 $(\beta x)/\beta\gamma)$
			K:L:M:N = 30:38:9:3
			$L_1:L_2:L_3$ = 30:14:10 E2
	40†	0.4536 6	sd pe
	630†	0.4782 2	α_K = 0.06 sd pe,ce
	1000†	0.6330 1	53† 1.3079* 7 sd pe
	93†	0.6726 5	70† 1.6098 8
	330†	0.8280 2	15† 1.7830 7
	410†	0.9310 1	27† 1.8827 8
	67†	1.1328 8	12† 1.959 2

(0.155 γ)(all γ's except 0.633 and 1.959 γ)

(0.633 γ)(0.454?, 0.672?, 0.828, 1.133, 1.308 γ)

No (1.959 γ) γ

No 0.375, 1.086γ (<10†) No 1.460γ (<20†)

γ(0.155 γ) delay ~$0.9^{m\mu s}$

Proposed decay scheme accommodates all γ's

*Double

M.W.Johns, C.C.McMullen, I.R.Williams, S.V. Nablo, Can. J. Phys. 34, 69 (1956); Phys. Rev. 91, 418 (1953).

$Re^{188}_{75\ 113}$ 17^h g.s.

$\gamma(Os^{188})$			$Re^{(187)}$(pile n,γ)		
1010†	0.150		58†	0.910	scin
120†	0.480		27†	1.130	
160†	0.630		22†	1.300	
3†	0.660*		21†	1.600	
65†	0.820		10†	1.770	

(0.48 γ)(0.15 γ)(θ) J = 2, 2, 0 & 0.48γ 99.6% E2

No (0.15 γ)(0.63 γ)

*Observed only with (0.15 γ)γ

V.R.Potnis, V.S.Dubey, C.E.Mandeville, Phys. Rev. 102, 459 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K7 (1956).

Os 76

No α's $\tau > 1x10^{17y}$ for $1.5 < E_\alpha < 2.5$; ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

Resonances Os(n)

E_o(ev)	$g\Gamma_n$(mev)	chopper Γ_γ(mev)
6.73 8	0.197 25	67 10
8.85 11	0.745 90	67 10
10.30 15	0.31 4	86 14
12.6 2	0.11 2	
18.8 3	0.70 7	44 10
22.0 4	1.86 22	62 14
27.9 6	3.17 55	
38.8 10	7.0 10	
41.2 10	0.55 8	
44.3 10	4.8 12	
50.6 14	7.1 16	
55.8 18	5.4 15	
63.1 20	22 5	
66.4 20	3.9 9	
78.2 30	62 22	
89.9 40	42 17	

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Ir 77

No α's $\tau > 1x10^{17y}$ for $1.5 < E_\alpha < 2.5$; ppl

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956).

Resonances Ir(n)

E_o(ev)	$g\Gamma_n$(mev)	chopper Γ_γ(mev)
5.36	3.4 13	31 14
6.125	0.15 1	44 7
9.05	1.84 25	57.5 86

E_o(ev)	$g\Gamma_n$*	E_o(ev)	$g\Gamma_n$*	E_o(ev)	$g\Gamma_n$*
9.89	0.14 1	24.25	24 5	50.8	52 17
10.4	0.049 5	29.2	7 1	61.2	22 4
10.8		30.6	2.4 5	66.3	51 11
11.2		35.2	0.9 2	75.6	69 17
18.7	0.81 16	39.7	4 2	93.5	141 38
19.65	0.61 10	41.7	37 9		

*units: mev

J.A.Radkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Ir^{192} 77 115 74^{d} E.S.

(0.604 γ)(0.316 γ)(θ) J = 3, 2, 0

V.W. Shiel, L.D. Wyly, C.H. Braden, Bull. Am. Phys. Soc. 1, No. 5, 264 F7 (1956).

(~0.3 γ)(~0.3 γ)(θ) scin
(0.468 γ)(0.316 γ)(θ)
(0.598 γ)(0.612 γ)(θ)
Consistent with J = 2 to 5, 2 to 5, 4(3), 2, 2, 0 for Pt^{192} levels at 1.201, 0.920, 0.784, 0.612, 0.316, g.s.

W.H. Kelly, M.L. Wiedenbeck, Phys. Rev. 102, 1130 (1956).

Pt 78

Relative isotopic abundances ms

Pt^{190}	0.0127% 5	Pt^{195}	33.8% 1
Pt^{192}	0.78% 1	Pt^{196}	25.2% 1
Pt^{194}	32.9% 1	Pt^{198}	7.19% 4

No Pt^{188} (<0.0013%)
No Pt^{189}, Pt^{191} (<0.0005%)
No Pt^{193}, Pt^{197}, Pt^{199}, Pt^{200} (<0.001%)

F.A. White, T.L. Collins, F.M. Rourke, Phys. Rev. 101, 1786 (1956).

Pt^{190}? 78 112 $9.6x10^{11y}$

τ $9.6x10^{11y}$* 5 natural Pt ppl
α 3.3 2 ppl
*Using 0.012% for abundance of Pt^{190}

W. Porschen, W. Riezler, Z. Naturf. 11a, 143 (1956); 9a, 701 (1954).

Pt^{191} 78 113 3.0^{d}

Pt^{190}(pile n,γ) chem
(0.130 γ)(0.220, 0.409 γ) scin
(~0.175 γ)(~0.175, 0.355 γ)

V.R. Potnis, C.E. Mandeville, J.S. Burlew, Phys. Rev. 101, 753 (1956).

Pt^{192}? 78 114 $\sim 10^{15y}$

τ $\sim 10^{15y}$ natural Pt ppl
α ~2.6 ppl

W. Porschen, W. Riezler, Z. Naturf. 11a, 143 (1956).

Pt^{193} 78 115 4.5^{d}

Pt^{192}(pile n,γ) chem
γ 0.130 scin
No γ with $E_\gamma > 0.7$ (<0.03%)

V.R. Potnis, C.E. Mandeville, J.S. Burlew, Phys. Rev. 101, 753 (1956).

Pt^{195} 78 117 ~6^{d}

Pt^{194}(pile n,γ) chem
γ 0.031 scin
0.099
0.130
(K x ray) (K x ray, 0.099, 0.130 γ)
(0.031 γ)(0.099 γ) No (0.099 γ)(0.130 γ)

V.R. Potnis, C.E. Mandeville, J.S. Burlew, Phys. Rev. 101, 753 (1956).

Pt^{197} 78 119 18^{h} E.S.

Pt^{196}(pile n,γ) chem

β⁻	0.468		scin βγ
	0.479	0.670	
γ(Au^{197})			
30†	0.077		scin
3.9†	0.191	α_K ~2.5*	
1†	0.279		

(0.468 β)(0.279 γ) (0.479 β)(0.191 γ)
(0.670 β)(0.077 γ) No 0.55 γ
(0.077 γ)(K x ray, 0.191 γ) No (0.279 γ)γ
*From (x)(0.077 γ)/(x)(0.191 γ)

V.R. Potnis, C.E. Mandeville, J.S. Burlew, Phys. Rev. 101, 753 (1956); 99, 671A (1955).

Pt^{200} 78 122

τ <4^{d} or >2^{y} Pt(pile n) chem
No activity observed with τ>4^{d}

G.W. Warren, R.W. Fink, Bull. Am. Phys. Soc. 1, No. 4, 171 E4 (1956); AECU-3165 (1956); priv. comm.

Au^{194} 79 115 39^{h}

β⁺	1.7†	1.21 2		sl β(0.30γ)
	1.3†	1.55 2		sl
γ(Pt^{194})			α_K	
	26†	0.2913 5	0.062 7	sl ce
	100†	0.3267 5	0.056 6	
	20†	0.640 20		scin
	9†	0.940 20		
	6†	1.120 20	α	sl ce
	6†	1.160 20	0.003 1	
	<2†	1.230 20		
	~2†	1.270 20	0.004 2	
	2†	1.340 20	0.007 3	
	8†	1.470 5	0.010 2	
	~1†	~1.50		(0.64γ)γ
	6†	1.590 20	0.003 1	sl ce
	7†	1.890 15	0.0014 4	
	5†	2.050 15	0.0018 5	
	~1†	2.150 15	0.013 5	
	~0.6†	~2.30		scin

(ce_K 0.291 γ)(0.327, 0.64, 0.94, 1.16, 1.47, 1.59 γ)
(ce_K 0.327 γ)(0.291, 0.64, 0.94, 1.16, 1.47, 1.59, 1.89 γ)
(0.30 γ)(0.30, 0.64, 0.94, 1.16, 1.47, 1.59, 1.89 γ)
(0.64 γ)(0.30, 0.64, 0.94, 1.16, 1.34, 1.50, 1.59 γ)
(0.94 γ)(0.30, 0.64, 0.94 γ)
Decay scheme proposed

M.T. Thieme, E. Bleuler, Phys. Rev. 102, 195 (1956); 99, 1646A (1955).

Au^{196} 79 117 5.6^{d}

β⁻ 12%* Pt(9.5-Mev d) chem; sl pe, ce

γ(Pt^{196})			α_K	K/LM
	28†	0.3310 4	0.059 4	2.0
	100†	0.3540 4	0.042 3	1.9

(0.331 γ)(ce_K 0.354 γ) (ce_K 0.331 γ)(ce 0.354 γ)
*From ratio (ce_{LM} 0.426 γ)/(ce_K 0.354 γ) and measured α's

M.T. Thieme, E. Bleuler, Phys. Rev. 101, 1031 (1956); 99, 1646A (1955).

Au^{197} 79 118

Level Au^{197}(α, α'γ) E_α = 3.0
γ (0.279) E2/M1 = 0.30 7 α,γ(t_4)

P.H. Stelson, P.K. McGowan, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Au^{198} 79 119

	ground state	Au^{197}(pile n,γ)
J	2	M
$\|\mu\|$	0.50 4	

R.L.Christensen, D.R.Hamilton, A.Lemonick, F.M.Pipkin, J.B.Reynolds, H.H.Stroke, Phys. Rev. 101, 1389 (1956); 99, 613A (1955).

Au^{198} 79 119 2.7^d

γ(Hg^{198}) 0.41176 19 α_K = 0.025 5 EA, α_L = 0.012 2 ce/β^*

$L_1 : L_2 : L_3$ = 19 ±3 : 22 ±3 : 10

*Total β's found from β background count at ce energy and theory of allowed β shape

D.R.Connors, W.C.Miller, B.Waldman, Phys. Rev. 102, 1584 (1956); 100, 1237A (1955).

Au^{198} 79 119

Resonance Au^{197}(n)

E_o(ev)	Γ_n(mev)	Γ_γ(mev)
61	86 24	170 80

Assumed g = 1/2

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Au^{199} 79 120

	ground state	$Pt^{(198)}$(pile n,$\gamma\beta$)
J	3/2	M
$\|\mu\|$	0.24 2	

R.L.Christensen, D.R.Hamilton, A.Lemonick, F.M.Pipkin, J.B.Reynolds, H.H.Stroke, Phys. Rev. 101, 1389 (1956); 99, 613A (1955).

Au^{199} 79 120 3.1^d

τ 3.148^d 10 $Pt^{(198)}$(n,$\gamma\beta$) chem

R.E.Bell, R.L.Graham, L.Yaffe, Can. J. Phys. 33, 457.

Hg 80

Resonances Hg(n)

E_o(ev)	Isotope	E_o(ev)	Isotope
23	199		
34	200	128	
43	202	177	200
73	200?	286	
90	199?	311	199?

chopper

Assignments by use of enriched isotopes

R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

Hg^{197} 80 117 23^h

γ	(0.133)	E2 = 100%	$ce_K\gamma(\theta)$
	(0.164)	E5/M4 ≤ 0.01	

(ce_L 0.164 $\gamma\gamma$(ce_L 0.133 $\gamma\gamma(\theta)$)*

(ce_K 0.164 $\gamma\gamma$(0.133 $\gamma\gamma(\theta)$)* J = 13/2, 5/2, 1/2

*Magnetic attenuation of correlation coefficients due to electron rearrangement shown

F.Gimmi, E.Heer, P.Scherrer, Helv. Phys. Acta, 29, 147 (1956); 28, 470A (1955).

Hg^{198} 80 118

Level	Hg^{198}(p,p'γ)	E_p = 4.5; scin	
γ	(0.411)	$\tau = 20^{\mu\mu s}$	(α = 0.04)

R.Barloutaud, T.Grjebine, M.Riou, Compt. rend. 242, 1284 (1956).

Hg^{199} 80 119 44^m

	0.159 level	$Hg^{(199)}$(pile n,n')
|q|	0.70^{*+40}_{-15}	$HgCl_2$ $\gamma\gamma(\theta)$

γ	(0.159)	E2 = 100%	liquid Hg
	(0.368)	E5/M4 ~ 0.008	$\gamma\gamma(\theta)$

*Using $eq(\partial^2V/\partial z^2)/h$ = 708 Mc/sec for Hg^{201}(1) and $Q(Hg^{201})$ = 0.45 (2)

R.V.Pound, G.K.Wertheim, Phys. Rev. 102, 396 (1956). (1) H.G.Dehmelt et al., Phys. Rev. 93, 480 (1954). (2) K.Murakawa, Phys. Rev. 98, 1285 (1955).

Hg^{199} 80 119

Levels	Hg^{199}(p,p'γ)	E_p = 4.5; scin	
γ	(0.159)	B(E2) = 0.32	(α = 0.65)
	(0.209)	B(E2) = 0.12	(α = 0.70)

R.Barloutaud, T.Grjebine, M.Riou, Compt. rend. 242, 1284 (1956).

Resonance $Hg^{(198)}$(n)

$\sigma_o(10^3b)$	E_o(ev)	Γ_n(mev)	chopper Γ_γ(mev)
4.3 10	23.3 2	5.8 5	145 20

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956); 95, 645A (1954).

Hg^{200} 80 120

Level	Hg^{200}(p,p'γ)	E_p = 4; scin	
γ	0.368	$\tau = 59^{\mu\mu s}$	(α = 0.06)

R.Barloutaud, T.Grjebine, M.Riou, Compt. rend. 242, 1284 (1956); Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Resonance $Hg^{(199)}$(n)

$\sigma_o(10^3b)$	E_o(ev)	$g\Gamma_n$(mev)	chopper Γ(mev)
8.4 14	34.0 3	39 3	360 40

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Hg^{202} 80 122

Level	Hg^{202}(p,p'γ)	E_p = 4; scin	
γ	(0.439)	$\tau = 31^{\mu\mu s}$	(α = 0.03)

R.Barloutaud, T.Grjebine, M.Riou, Compt. rend. 242, 1284 (1956); Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Hg^{203} 80 123 47^d

β^-	100%	0.195 2	Hg^{202}(pile n,γ); sd	
γ(Tl^{203})	0.2783 5	α_K = 0.13 1	K/LM = 2.75	sd ce

No 0.473β (<0.03%)

J.L.Wolfson, Can. J. Phys. 34, 256 (1956).

Hg^{203} 80 123 47 d

$\gamma(Tl^{203})$ (0.279) $Hg^{(202)}$(pile n,γ) ms
$\alpha_K = 0.159$ 4 sd ce/β
$\alpha_{L1} = 0.0247$ 3*
$\alpha_{L2} = 0.0160$ 2*
$\alpha_{L3} = 0.0084$ 2*
*Excluding systematic error of 40

C. Nordling, K. Siegbahn, E. Sokolowski, Nuclear Phys. 1, 326 (1956).

$\gamma(Tl^{203})$ (0.279) $\alpha_K = 0.15$ 1 sl ce, cp
K/LM = 3.2

Z. O'Friel, A.H. Weber, Phys. Rev. 101, 1076 (1956).

Hg^{204} 80 124

Level Hg^{204}(p,p'γ) $E_p = 4$; scin
γ 0.43 1 $\tau \sim 73^{\mu\mu s}$ ($\alpha = 0.03$)

P. Barloutaud, T. Grjebine, M. Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Hg^{206} 80 126

τ $< 10^h$ or $> 2^y$ Hg^{204}(pile n) chem
No activity observed with $\tau > 10^h$

R.W. Fink, G.W. Warren, B.L. Robinson, R.R. Edwards, Bull. Am. Phys. Soc. 1, No. 4, 171 E5 (1956); AECU-3165 (1956).

Tl ? 81

γ $Tl(\gamma,?\gamma)$ $E_\gamma \leq 22$; scin
0.410 15 $\gamma\gamma$ delay = $65^{\mu s}$ 5
0.485 20 $\gamma\gamma$ delay = $530^{\mu\mu s}$ 50
$\alpha_K \sim 0.25$ x/γ
0.706 20 $\gamma\gamma$ delay = $65^{\mu s}$ 5

S.H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

Tl^{203} 81 122

Levels $Tl^{(203)}$(p,p'γ) $E_p = 4$
γ (0.279) $\epsilon B(E2) = 0.07$ scin
0.680

P. Barloutaud, T. Grjebine, M. Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Level $Tl^{203}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ (0.279) E2/M1 = 2.25 25 $\alpha,\gamma(L)$

P.H. Stelson, F.K. McGowan, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Tl^{205} 81 124

γ $Tl^{(205)}$(p,p'γ) $E_p = 4$
0.205 $\epsilon B(E2) = 0.07$ scin
~4† 0.410
100† 0.615

P. Barloutaud, T. Grjebine, M. Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

Pb 82

Relative isotopic abundances [81]
Pb^{204} 1.40% 2 Pb^{207} 21.7% 1
Pb^{206} 25.2% 1 Pb^{208} 51.7% 2
No Pb^{202} (< 0.003%) No Pb^{203} ($< 4 \times 10^{-4}$%)
No Pb^{205} (< 0.001%) No Pb^{209} ($< 5 \times 10^{-5}$%)
No Pb^{210}, Pb^{211}, Pb^{212} ($< 7 \times 10^{-6}$%)
No Pb^{213} ($< 5 \times 10^{-6}$%)

F.A. White, T.L. Collins, F.M. Rourke, Phys. Rev. 101, 1786 (1956).

Pb^{202} 82 120 3.5 h

(0.961 $\gamma\gamma$)(0.422γ) delay < $1^{\mu\mu s}$
γ(0.961γ) delay < $1^{\mu\mu s}$

G.K. Wertheim, R.V. Pound, Phys. Rev. 102, 185 (1956); priv. comm.

Pb^{204} 82 122 68 m

1.27 level Tl(22-Mev d)
μ +0.22 2 $\gamma\gamma(\theta,H)$
Pb^{204}(n,n'); $^{12h}Bi^{204}$ chem
γ 0.374 E2 = 100% scin, $\gamma\gamma(\theta)$
0.890 E2 = 100%
0.905 E5 = 100%
(0.905 $\gamma\gamma$)(0.374, 0.890γ) delay = $0.26^{\mu s}$ 2
(0.374 $\gamma\gamma$)(0.890 $\gamma\gamma(\theta)$ J = 4, 2, 0
(0.905 $\gamma\gamma$)(0.374 $\gamma\gamma(\theta)$) } J = 9, 4, 2, 0
(0.935 $\gamma\gamma$)(0.890 $\gamma\gamma(\theta)$) }

J.R. Huizenga, V.E. Krohn, S. Raboy, Phys. Rev. 102, 1063 (1956); Bull. Am. Phys. Soc. 1, No. 1, 43 K10 (1956); Phys. Rev. 98, 1354 60BA (1954); 97, 1017 (1955); 98, 231A (1955).

γ 0.371 M3/E2 = 0.0025 $\gamma\gamma(\theta)$
0.895 E2 = 100% scin
0.910
(0.371 $\gamma\gamma$)(0.895 $\gamma\gamma(\theta)$ J = 4, 2, 0
Time-dependent attenuation function for $0.26^{\mu s}$ level differs from theoretical value

G.K. Wertheim, R.V. Pound, Phys. Rev. 102, 185 (1956).

Pb^{206} 82 124

Level $Pb^{(206)}$(p,p'γ) $E_p = 4.6$
γ (0.803) $\tau = 7.5^{\mu\mu s}$ scin

P. Barloutaud, T. Grjebine, M. Riou, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956); verbal report.

$Pb^{(207)}(\gamma,n\gamma)$ $E_\gamma \leq 22$; scin
γ(0.343, 0.516, 0.537, 0.802, 0.880γ) delay = $132^{\mu s}$ 10
Threshold = 10.38 45

S.H. Vegors, Jr., P. Axel, Phys. Rev. 101, 1067 (1956).

Bi^{203} 83 120 12 h

No γ Pb^{206}(>31-Mev p,4n) chem; scin
Observed γ's assigned to $^{12h}Bi^{204}$, $^{52h}Pb^{203}$

G.K. Wertheim, R.V. Pound, Phys. Rev. 102, 185 (1956).

$Bi^{204}_{83\ 121}$ 12^h

τ 11.6^h 2 Pb^{206}(31-Mev p,3n) chem

$\gamma(Pb^{204})$	0.371		sd ce, scin
	0.668	1.20	
	0.895	1.73	
	0.981	2.10	

(0.981 γ)(0.668, 1.20γ)

0.668, 0.981, 1.20, 1.73γ's precede $0.26^{\mu s}$ level

0.981γ/0.910γ = 0.75 from decrease in delayed (0.9 γ)(0.9 γ) after chemical separation of Pb

G.K.Wertheim, R.V.Pound, Phys. Rev. 102, 185 (1956).

$Bi^{207}_{83\ 124}$ 8.0^y

$\gamma(Pb^{207})$	0.5697 1	sd ce_K

$H\rho(ce_K\ 0.5697\gamma) = 2838.9$ 4

G.Bäckström, Arkiv Fysik 10, 393 (1956).

$\gamma(Pb^{207})$ 0.5697 2

P.Marmier, F.Boehm, quoted by D.E.Alburger, A.W.Sunyar, Phys. Rev. 99, 695 (1955).

$Bi^{209}_{83\ 126}$ $2x10^{17y}$

τ $2x10^{17y}$ 1

α 3.0 2

12 tracks found in Bi impregnated plates stored 100 to 180 days

W.Porschen, W.Riezler, Z. Naturf. 11a, 143 (1956); 7a, 634 (1952).

$Bi^{209}_{83\ 126}$

γ $Bi^{209}(\gamma,\gamma)$ $E_\gamma \leq 22$; scin

0.500 20 $\gamma\gamma$ delay = 2.70^{ns} 25

0.930 30 = 2.70^{ns} 25

S.H.Vegors, Jr., P.Axel, Phys. Rev. 101, 1067 (1956); 100, 1238A (1955).

$Bi^{210}_{83\ 127}$ 5.0^d

τ 5.013^d 5 differential ic

J.Robert, J.Tobailem, J. phys. radium 17, 440 (1956).

$e^+/\beta^- < 1.2 \times 10^{-4}$ cc

A.B.Milojević, Bull. Inst. Nuclear Sci. Boris Kidrich 6, 21 (1956).

$Bi^{210}_{83\ 127}$

Resonance peaks	Bi^{209}(n) E_o(kev)	l_n	Li(p,n) E_o(kev)	l_n
	~1			
	~3	0	34	0
	13	0	47	0
	16		70	0

J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

$Bi^{214}_{83\ 131}$ 20^m

τ 19.9^m 4 d $27^m Pb^{214}$ chem and $27^m Pb^{214}$ source; sl

β^-	9%	0.42 15	9%	1.88 8
	23%	1.02 12		
	40%	1.51 5	19%	3.26 3

No 2.6β

H.Daniel, R.Nierhaus, Z. Naturf. 11a, 212 (1956).

$Po^{209}_{84\ 125}$ 103^y

τ 103^y 4

From sample with $Po^{209}/Po^{208} = 0.176$ 2, $(Po^{209}\ \alpha)/(Po^{208}\ \alpha) = 0.0050$ 2, and $\tau(Po^{208}) = 2.93^y$ 3

C.G.Andre, J.R.Huizenga, J.P.Mech, W.J. Ramler, E.G.Rauh, S.R.Rocklin, Phys. Rev. 101, 645 (1956).

$Po^{217}_{84\ 133}$ $<10^s$

τ		$<10^s$	$25^m Rn^{221}$ recoil
β^-	<20%	$(Pr^{221}\ \alpha)/(At^{217}\ \alpha) = 1.00$ 5	ic
α		6.54 2	

F.F.Momyer, Jr., E.K.Hyde, Phys. Rev. 101, 138 (1956).

$At^{211}_{85\ 126}$ 7.2^h

Bi^{209}(29-Mev α,2n) chem

τ		7.20^h 5	ic α
γ	4†	0.06235 50	cryst
x	100†	K x ray	cryst
ce		0.0460 3 ?	sm ce

P.R.Gray, Phys. Rev. 101, 1308 (1956).

$Rn^{220}_{86\ 134}$ 52^s

$\gamma(Po^{216})$ Rn collected from Th^{228}

~2.5† 0.542 2 scin

Not emitted in decay of $0.16^s Po^{216}$ (intensity changed <10% by reversal of electric field)

†Photons per 10^4 disintegrations

L.Madansky, F.Rasetti, Phys. Rev. 102, 464 (1956).

$Rn^{221}_{86\ 135}$ 25^m

τ 25^m 2 Th^{232}(110-Mev p) chem

$\beta/\alpha = 4 \pm 1$ $(At^{217}\alpha)/(Po^{217}\alpha)$ ic

p At^{217} and Po^{213} (7.02α, 8.34α observed)

F.F.Momyer, Jr., E.K.Hyde, Phys. Rev. 101, 138 (1956).

$Rn^{222}_{86\ 136}$ 3.8^d

$\gamma(Po^{218})$ Rn collected from Ra^{226}

~7† 0.510* 2 scin

Intensity remained constant for first 2 min after collection, ∴ not in decay of $3^m Po^{218}$

*No (0.51 γ)(0.51γ), hence not γ^2

†Photons per 10^4 disintegrations

L.Madansky, F.Rasetti, Phys. Rev. 102, 464 (1956).

Ra^{225} 88 137 15[d] — $\beta(0.040\,\gamma)$ delay $< 4^{m\mu s}$

D. Strominger, J. O. Rasmussen, Phys. Rev. 100, 844 (1955).

$\alpha/\beta^- < 0.01\%$ — Th^{229} chem
No $25^{m}Rn^{221}$ observed — ic

F. P. Momyer, Jr., E. K. Hyde, Phys. Rev. 101, 136 (1956).

Th^{228} 90 138 1.9[y] — τ **1.910[y]** *2* — Ra^{226}(pile n) chem

H. W. Kirby, G. R. Grove, D. L. Timma, Phys. Rev. 102, 1140 (1956).

Th^{231} 90 141 26[h] — $\beta(0.026,\ 0.085\,\gamma)$ delay $= 410^{\mu s}$ *40*

D. Strominger, J. O. Rasmussen, Phys. Rev. 100, 844 (1955).

Th^{232} 90 142 1.4×10^{10}y — τ **1.45×10^{10}y** *5* Specific activity

R. L. Macklin, H. S. Pomerance, J. Nuclear Energy 2, 243 (1956).

Th^{233} 90 143 — Resonances Th^{232}(n) — chopper

E_o(ev)	Γ_γ(mev)
(22.1, 23.8)	30 *10* for each

Used $\sigma_o\Gamma^2 = 7 \pm 2, 13 \pm 4$ for 22.1, 23.8 resonances respectively

J. S. Levin, D. J. Hughes, Phys. Rev. 101, 1328 (1956).

Resonances Th^{232}(n) — chopper

E_o(ev)	Γ_n(mev)	Γ_γ(mev)
22.0 *2*	1.24 *36*	**28** *11*
23.6 *2*	3.35 *77*	**25** *8*

E_o(ev)	Γ_n(mev)*	E_o(ev)	Γ_n(mev)*
60 *1*	**6.8** *19*	**210** *4.5*	**1.8** *14*
70.7 *9*	**44** *13*	**225** *5*	**16** *9*
115 *2*	**15** *5*	**235** *5.4*	**14** *8*
125 *2*	**25** *10*	**260** *6*	**45** *3*
135 *2.3*	**15** *6*	**270** *6.5*	**60** *12*
175 *3.4*	**36** *10*	**295** *7.5*	**12** *7*
195 *4*	**22** *7*	**350** *9*	**205** *50*

*Assuming $\overline{\Gamma_\gamma} = 25$ mev

J. A. Radkevich, V. V. Vladimirsky, V. V. Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Th^{234} 90 144 24[d] — $\alpha/\beta < 10^{-6}$ — ppl

S. Deutsch, M. Nikolic, Nuovo Cim. 2, 1326 (1955).

Th^{234} 90 144 24[d] — $\gamma(Pa^{234})$ — d U^{238} chem

5%	**0.0290**		
5%	**0.0628**	$\alpha_L = 0.45$	
16%	**0.0914**	$\alpha_{L1} = 2.0$	L/MN = 3.1

($\sim 0.08\beta$)(ce_K 0.0914 γ)
No 0.0471 γ (ce's reinterpreted)
No 0.100 γ (assigned to $6.7^{h}Pa^{234}$)
No 0.043 γ (assigned to 1.2^{m} and $6.7^{h}Pa^{234}$)

Ong Ping Hok, J. T. Verschoor, P. Born, Physica 22, 465 (1956).

Pa^{234} 91 143 1.2^{m} — τ **1.25^{m}** *10* — d $24^{d}Th^{234}$ chem, $24^{d}Th^{234}$ source

$\gamma(U^{234})$

2.5%	**0.0430**			sd ce, scin
	0.230	1.5%	**1.01**	
0.10%	**0.255**		**1.24**	
0.87%	**0.770**	0.09%	**1.44**	
0.16%	**0.803**	0.07%	**1.69**	
	0.807	0.11%	**1.83**	

$1.2^{m}Pa^{234}$ level 0.060 *15* above $6.7^{h}Pa^{234}$ from tentative decay scheme

Ong Ping Hok, J. T. Verschoor, P. Born, Physica 22, 465 (1956).

Pa^{234} 91 143 6.7^{h} z.s. — β^-

28%*	**0.155**						d $24^{d}Th^{234}$ chem; sd
32%	**0.32** *2*						
27%	**0.53** *2*						
13%	**1.13** *5*	ce's per 1000 β's					
		K	L_1	L_2	L_3	M	
$\gamma(U^{234})$							
20%	**0.0430**			65	60	51	scin,
14%	**0.0992**			59	44	28	sd ce
15%	**0.125**						
7%	**0.153**			15	7	5.5	
13%	**0.225**	44	7.5			2	
	0.293						
	0.333						
3.5%	**0.368**	6	1.7				
7%	**0.566**	6	1.7				
	0.603						
9%	**0.732**	1.2	0.7				
0.2%	**0.803**	1.2	0.5				
14%	**0.877**	1.5	1.1			0.9	
25%	**0.924**	1.1					
	1.24						
3.5%	**1.43** *3*						
2.5%	**1.68** *3*						

*Uncertain (10% from γ intensities)

Ong Ping Hok, J. T. Verschoor, P. Born, Physica 22, 465 (1956); 19, 1205 (1953); Phys. Rev. 99, 1613 (1955).

U 92 — Relative isotopic abundances — ms

U^{234}	**0.0056%** *1*
U^{235}	**0.718%** *5*
U^{238}	**99.276%** *5*

No U^{232}, U^{233} ($< 6 \times 10^{-5}$%)
No U^{236} ($< 2 \times 10^{-4}$%)
No U^{237}, U^{239} ($< 1 \times 10^{-4}$%)
No U^{240} ($< 5 \times 10^{-5}$%)

F. M. White, T. L. Collins, F. M. Rourke, Phys. Rev. 101, 1786 (1956).

U 92

Relative isotopic abundances ms

U^{234}	0.0057%*	2
U^{235}	0.7204%	7
U^{238}	99.2739%	7

*Assumed value

M.Lounsbury, Can. J. Chem. 34, 259 (1956).

U^{235} 92 143

ground state

J 7/2 para

$|\mu|$ 0.38 or 0.31

C.A.Hutchison, Jr., P.M.Llewellyn, E.Wong, P.Dorain, Phys. Rev. 102, 292 (1956).

U^{239} 92 147

Resonances $\sigma_o(10^3 b)$	$U^{(238)}$(n) E_o(ev)	$\Gamma(10^{-3}$ev)	chopper $\Gamma_\gamma(10^{-3}$ev)
23 3	6.70 6	26 2	24 2
27 6	21.1 2	38 6	30 6
30 10	37.1 4	70 20	40 20

J.S.Levin, D.J.Hughes, Phys. Rev. 101, 1328 (1956).

Resonances $\sigma_o(10^3 b)$	$U^{(238)}$(n) E_o(ev)	Γ_n(mev)*	chopper Γ_γ(mev)
20.0 18	6.69 2.5	1.15 4	21.2 13
17.0 25	21.0 1	6.35 59	36.0 35
25.0 75	37.0 4	22.0 35	34 10
14 10	67.7 8	19.1 45	25 12
	83 11	2.7 11	21 15
	90 12	0.09 8	
	105 1.4	52 5	
	120 2	38 2	
	135 2.3	2.4 19	
	142 2.4	0.5 4	
	146 2.5	4 3	
	165 3	0.97	
	194 3.5	119 10	
	202 4	75 6	
	240 5	70 21	
	254 6	20 11	
	272 7	55 7	
	291 8	148 1	
	355 10	140 90	
	405 12	260 80	

*Assuming $\overline{\Gamma}_\gamma$ = 30 mev except when measured

J.A.Nadkevich, V.V.Vladimirsky, V.V.Sokolovsky, Amsterdam Conf. Nuclear Reactions, July 1956; Physica 22 (1956).

Np^{236} 93 143 22^h

β^-	0.518 10*			sl
γ	0.0435 10	L:M:N 48:18:3		sd ce
	0.0442 10			

No 0.150γ (0.038 ce now interpreted as ce_M 0.044γ's rather than ce_K 0.150γ)
$ce/\beta \sim 0.35$

P.R.Gray, Phys. Rev. 101, 1306 (1956); *G.D. O'Kelley, ibid.

Pu^{240} 94 146

Resonances $\sigma_o\Gamma^2 = 1.6$	Pu^{239}(n) E_o(ev) 0.01	Γ(ev) 0.063	chopper, cryst $g\Gamma_n$(mev) 0.001
$\sigma_o = 5300$	0.300 5	0.101 5	0.063 3

Resonances also observed at 7.8, 11.3, 16 ev

N.J.Pattenden, J. Nuclear Energy 2, 187 (1956).

Pu^{241} 94 147 13^y

τ 12.95^y 28 Pu chem

From growth of 0.060γ of 461.3^{7}Am^{241}

B.Rose, J.Milsted, J. Nuclear Energy 2, 284 (1956).

Pu^{241} 94 147

Resonance $\sigma_o(10^5 b)$	Pu^{240}(n) E_o(ev)	chopper, cryst Γ_n(mev)	Γ_γ(mev)
1.5 2	1.06 1	1.80 40	27 6

N.J.Pattenden, J.Nuclear Energy 2, 187 (1956).

Resonance $\sigma_o(10^5 b)$	$Pu^{(240)}$(n) E_o(ev)	Γ(mev)	cryst Γ_n(mev)
1.78 16	1.075 5	42 5	6.2 9

Y.G.Abov, Conf. Acad. Sci. USSR on Peaceful Use of Atomic Energy, Phys. Math. Sci. p.249 July (1955); Consultants Bureau Trans. p.209.

Pu^{242} 94 148 3.7×10^{5y}

Am^{241}(pile n,$\gamma\epsilon$) chem

τ 3.73×10^{5y} 5 ic,ms

From ratios of α's and atoms of Pu^{242} and Pu^{238} using $\tau = 89.6^y$ for Pu^{238}

τ for spontaneous fission = 6.64×10^{10y} 10

J.P.Butler, M.Lounsbury, J.S.Merritt, Can. J. Chem. 34, 253 (1956).

Pu^{246} 94 152 11^d

τ		10.85^d 2		
β^-	73%	0.15 1		scin $\beta\gamma$
	27%	0.33 3		
$\gamma(Am^{246})$				scin $\gamma\gamma$
	330†	0.027 3	$\alpha \leq 1.9$	γ/γ
	780†	0.047 2	$\alpha \leq 0.23$	γ/γ
	90†	0.075 to 0.085		
	w	0.099 5		
	84†	0.175 5	$\alpha_K \sim 6$	K/L = 4.8* x/γ
		0.215 10		scin
x	500†	K x ray		

(0.15β)(0.047, 0.175γ) (0.33β)(0.047γ)
(0.175γ)(0.027, 0.047, 0.070? γ)
(0.047γ)(0.027, 0.075 to 0.085, 0.099, 0.175γ, L x ray, K x ray)
No 0.40β (<5% from equality of intensity of Pu^{246} and Am^{246} β's)

D.C.Hoffman, C.I.Browne, J. Inorg. Nuclear Chem. 2, 209 (1956); *H.L.Smith et al., ibid.

Am^{241} 95 146

	ground state	
μ	+1.4	S
q	+4.9	

T.E.Manning, M.Fred, F.S.Tomkins, Phys. Rev. 102, 1108 (1956).

Am^{241} 95 146 461^y

τ 461.3^y *17* specific activity

G.R.Hall, T.L.Markem, J. Inorg. Nuclear Chem. 2, 202 (1956).

$\gamma(Np^{237})$

	$L_1:L_2:L_3$	$M_1:M_2:M_3:M_{45}$
(0.033)		~4 :~1: 1
(0.043)	10:10:10	
(0.056)	~1: 1	~1 :~1: 1
(0.060)*	15:33:10	17 : 36:10:1
(0.099)	~0:>1: 1	

*L:M:N:O = 10:3:1: ~0.3 sπ ce

J.M.Hollander, W.G.Smith, J.O.Rasmussen, Phys. Rev. 102, 1372 (1956).

Am^{243} 95 148

	ground state	
μ	+1.4	S
q	+4.9	

$\mu(Am^{241})/\mu(Am^{243})$ = +1.00 *1*

$Q(Am^{241})/Q(Am^{243})$ = +1.00 *1*

T.E.Manning, M.Fred, F.S.Tomkins, Phys. Rev. 102, 1108 (1956).

Am^{243} 95 148 8800^y

α(0.075 γ) delay $< 2^{n}\mu s$

D.Strominger, J.O.Rasmussen, Phys. Rev. 100, 844 (1955).

Cm^{242} 96 146

$\gamma(Pu^{238})$

0.04411 *5*	L_2/L_3 = 1.2	sπ ce
	M_2/M_3 = 1.2 N_2/N_3 ~1	
	L:M:N = 26:10:3	
0.1019 *3*	M_2/M_3 = 1.5 L/M~3	
	$L_1:L_2:L_3$ = ~2:14:10	
0.1577 *5*		

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 746 (1956).

Cm^{244} 96 148 18^y

$\gamma(Pu^{240})$ 0.04288 *5* L_2/L_3 = 1.0 sπ ce
M_2/M_3 = 1.0 N_2/N_3 ~1
L:M:N = 25:10:3

W.G.Smith, J.M.Hollander, Phys. Rev. 101, 746 (1956).

Cm^{246} 96 150 ~3000^y

α 5.4 H-bomb debris chem, ms
τ for spontaneous fission > 1.2×10^{7y} ic

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

Cm^{249} 96 153 65^m

τ 65^m Cm(pile n)
β^- 0.9

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

Cm^{250} 96 154

τ_β $>130^y$
From absence of Cf^{250} in H-bomb debris

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

Bk^{248} 97 151 23^h

τ 23^h 5 Cm(25-Mev α) chem
From milking of $250^d Cf^{248}$ (6.3 α observed)

E.K.Hulet, Phys. Rev. 102, 182 (1956).

Cf^{254} 98 156 55^d

τ 55^d H-bomb debris chem
Decays by spontaneous fission

P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

E^{253} 99 154 20^d

τ		20.63^d *1*	Pu(pile n) chem
α	~0.08%	6.24 *2*	ic
	100%	6.636 *5*	
$\gamma(Bk^{249})$			scin
	3.8†	0.042 *3*	α_L ~34 (ω_L = 0.50) x/γ
	5.5†	0.393 *5*	α_K ~0.66 x/γ
x	65†	L x ray	
	3.6†	K x ray	

(6.24 α)(0.393 γ)
τ for spontaneous fission = 7×10^{5} *3*
†Photons per 10^4 α's

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

E^{254} 99 155 ~320^d s.a.

τ ~320^d Pu(pile n) chem
α 6.42 *2* ic
p $3^h Bk^{250}$ recoil

M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

$_{99}E^{254}_{155}$ 38.5^h 10

τ	38.5^h 10	Pu(pile n)	chem
β^-	1.04 4		a
$\gamma(Pm^{254})$ ~70†	0.668 15		scin

†Photons per 100 β's

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, Phys. Rev. 102, 203 (1956).

$_{99}E^{255}_{156}$ 24^d

τ	24^d 2	Pu(pile n)	chem
p $22^h Fm^{255}$ (α pulse analysis)			

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, Phys. Rev. 102, 203 (1956).

$_{100}Fm^{252}_{152}$ 23^h

τ	22.7^h 7	Cf(34-Mev α)	chem
α	7.04 2		ic

p $250^d Cf^{248}$ (from increase of 6.3 α)
τ for spontaneous fission > 3000^d

A. M. Friedman, J. E. Gindler, R. F. Barnes, R. Sjoblom, P. R. Fields, Phys. Rev. 102, 585 (1956).

$_{100}Fm^{253?}_{153}$ $>10^d$

τ	$>10^d$	Cf(34-Mev α)	chem
α	6.85		ic

A. M. Friedman, J. E. Gindler, R. F. Barnes, R. Sjoblom, P. R. Fields, Phys. Rev. 102, 585 (1956).

$_{100}Fm^{254}_{154}$ 3.2^h

τ	3.24^h 1	Pu(pile n)	chem
α	7.20 1		ic

τ for spontaneous fission = 246^d

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, Phys. Rev. 102, 203 (1956).

$_{100}Fm^{255}_{155}$ 22^h

τ	21.5^h 1	Pu(pile n)	chem
α	7.08 1 double?		ic

M. Jones, R. P. Schuman, J. P. Butler, G. Cowper, T. A. Eastwood, H. G. Jackson, Phys. Rev. 102, 203 (1956).

TABLE 2—NEUTRON CROSS SECTIONS

Absorption cross sections for neutron energies marked "th" (thermal) have been determined, from measurements in a thermal neutron flux, in terms of the cross section value of a "standard" for neutrons of velocity 2200 m/sec, or energy ~0.025 ev. The standard used, when clearly stated by the experimenter, is given just after the reference and is generally one known to have a thermal absorption cross section with 1/v energy dependence. If the nucleus whose cross section is being measured also has a cross section with 1/v dependence, the cross section found for it by comparison with the standard will, of course, be a cross section for 2200 m/sec. If not, and the dependence often is not known, the value found by the comparison is $\overline{\sigma v}/2200$.

Cross sections for inelastic scattering are given in a way which indicates the experimental method used. For instance, "n, 2.00n′ (90°)" in the "Type of σ" column, means that the cross section given is for the production of 2.00-Mev neutrons at 90° to the incident beam (in barns per steradian) and that these neutrons were observed experimentally. The energy of the incoming neutrons is given in the column headed "Energy". If it is 2.45 Mev, the energy loss in the inelastic process was 0.45 Mev. If the σ type is shown as "n,n′ + 1.00γ (90°)" the cross section given is for the production of 1.00 Mev γ's. In this case γ's, not neutrons, were observed at 90°. The energy lost by the neutron is then 1.00 Mev or more depending on whether or not another γ ray, unobserved in the experiment, was in cascade with the 1.00-Mev γ.

Target	Energy	Type of σ	Value of σ or $\int\sigma d\Omega$	Method	Ref.
Li	4.4 to 5.5 7.8 to 8.6	t	graphs		56B62
Be^9	4.4 to 5.5 7.8 to 8.6	t	graphs		56B62
B	4.4 to 5.5 7.8 to 8.6	t	graphs		56B62
B^{10}	4.4 to 5.5 7.8 to 8.6	t	graphs		56B62
C	4.4 to 5.5 7.7 to 8.6	t	graphs		56B62
	55	t-el	0.28 3	"sphere"	56V11
	81	t-el	0.20 2	"sphere"	56V11
	105	t-el	0.234 8	"sphere"	56V11
	140	t-el	0.22 1	"sphere"	56V11
N	4.4 to 5.5 7.8 to 8.6	t	graphs		56B62

Neutron Cross Sections continued

Target	Energy	Type of σ	Value of σ or ∫σdΩ	Method	Ref.
O	4.4 to 5.5 7.7 to 8.6	t	graphs		56B62
F^{19}	4.4 to 5.5	t	graph		56B62
Mg^{26}	pile	n,γ	0.025 *2*	9.5^{m}Mg	56L06
Al	1.75 to 7	t-el	table	sphere	56B49
	55	t-el	0.50 *4*	"sphere"	56V11
	81	t-el	0.41 *3*	"sphere"	56V11
	105	t-el	0.43 *1*	"sphere"	56V11
	140	t-el	0.42 *1*	"sphere"	56V11
Si^{28}	4.4 to 8.0	n,p	graph	2.3^{m}Al	56M06
Cl	0.03ev	t	44		56B35
	5 kev	t	1.3		56B35
Ti	1.75 to 7	t-el	table	sphere	56B49
Cr	2.50	n,1.05n′	0.6 *2*	scin n	56B40
Mn^{55}	0.1 to 2.0	n,n′+0.13γ	graph	scin γ	56G15
	2.50	n,1.56n′	0.4	scin n	56B40
	2.50	n,1.13n′	0.3	scin n	56B40
	2.50	n,0.85n′	0.1	scin n	56B40
Fe	1 to 120kev	t	graph		56G32
	1.75 to 7	t-el	table	sphere	56B49
Co^{59}	14	n,α	0.031 *3*	2.6^{h}Mn	56B50
Cu	55	t-el	1.12 *1*	"sphere"	56V11
	81	t-el	0.84 *4*	"sphere"	56V11
	105	t-el	0.77 *1*	"sphere"	56V11
	140	t-el	0.74 *1*	"sphere"	56V11
Zn	2.5	t-el	1.30	sphere	56B49
	7	t-el	1.61	sphere	56B49
Zn^{64}	14	n,p and n,np	0.590 *75*	ppl	56R29
$Zn^{(68)}$	14	n,α	0.0082 *16*	2.6^{h}Ni	56B50
$Br^{(79)}$	14	n,α	0.010 *2*	26.5^{h}As	56B50
Kr	th	s coh	7.4 *4*	liquid mirror	56C30
$Sr^{(84)}$	pile	n,γ	1.6 *1*	65^{d}Sr	56A16
Zr	1.75 to 7	t-el	table	sphere	56B49
Nb^{93}	14	n,α	0.0090 *22*	64^{h}Y	56B50
Pd	14	t	4.30 *10*		56H42
$Pd^{(108)}$	14	n,α	0.0023 *5*	4.4^{h}Ru	56B50
Ag	2.5	t-el	2.07	sphere	56B49
	7	t-el	2.00	sphere	56B49

Neutron Cross Sections continued

Target	Energy	Type of σ	Value of σ or ∫σdΩ	Method	Ref.
Cd	~1 to 2000ev	t	graph		56P15
	1.75 to 7	t-el	table	sphere	56B49
	14	t	4.37 *10*		56H42
	55	t-el	1.55 *2*	"sphere"	56V11
	81	t-el	1.25 *5*	"sphere"	56V11
	105	t-el	1.20 *3*	"sphere"	56V11
	140	t-el	1.07 *2*	"sphere"	56V11
$In^{(115)}$	14	n,α	0.0020 *4*	3.2^{h}Ag	56B50
Sn	1.75 to 7	t-el	table	sphere	56B49
I^{127}	0.1 to 1.2	n,n′+0.060γ	graph	scin γ	56G15
I^{129}	pile	n,γ	35	12.5^{h}I	56P25
Xe	th	s coh	3.3 *2*	liquid mirror	56C30
Cs^{133}	14	n,α	0.0010 *3*	12.5^{h}I	56B50
Nd	14	t	5.08 *10*		56H42
Sm	14	t	5.12 *10*		56H42
Hf	0.5 to 7.0ev	t	graph		56I01
	0.3 to 2.0	n,n′+~0.23γ	graph	scin γ	56G15
	14	t	5.44 *10*		56H42
Ta^{181}	0.1 to 1.8	n,n′+0.14γ	graph	scin γ	56G15
	14	t	4.96 *10*		56H42
W	0.3 to 1.8	n,n′+~0.12γ	graph	scin γ	56G15
Re	0.1 to 1.9	n,n′+~0.13γ	graph	scin γ	56G15
Pt	0.3 to 1.8	n,n′+~0.33γ	graph	scin γ	56G15
Au^{197}	0.3 to 1.6	n,n′ + 0.27γ	graph	scin γ	56G15
	1.75 to 7	t-el	table	sphere	56B49
Au^{198}	th	n,γ	26×10^{3} *1*	3.16^{d}Au	55B142
	pile	n,γ	26×10^{3} *1*	S	55B101
Au^{199}	th	n,γ	$<3 \times 10^{3}$	48^{m}Au	55B142
Pb	10	t-el	2.58	sphere	56B79
	55	t-el	2.34 *2*	"sphere"	56V11
	81	t-el	2.00 *3*	"sphere"	56V11
	105	t-el	1.72 *4*	"sphere"	56V11
	140	t-el	1.70 *2*	"sphere"	56V11
Bi^{209}	1 to 50 kev	t	graph		56G32
	10	t-el	2.52	sphere	56B79
	1.75 to 7	t-el	table	sphere	56B49
Ac^{227}	th	n,γ	510 *36*	osc	56K16
Pa^{231}	th	n,γ	200 *15*	1.3^{d}Pa	56S25
Pa^{232}	pile	n,γ	760 *100*	27^{d}Pa	56S25
Pa^{233}	pile	n,γ	140 *20*	ms	56H14

Neutron Cross Sections continued

Target	Energy	Type of σ	Value of σ or ∫σdΩ	Method	Ref.
U^{233}	0.0044, 0.0118	a	table	sphere	56M40
U^{235}	0.005 to 0.05	a	graph	sphere	56M40
	0.4 to 1.6	f	graph		53D41
	1.25	f	1.27 4		53D41
Np^{239}	pile	n,γ	80 15	ms	56H31
Pu^{239}	0.005 to 0.05	a	graph	sphere	56M40
	th	t	1015 30		56P10
	pile	n,γ	400 40	ms	56H31
Pu^{240}	th	f	4.4 5		56H37
	pile	n,γ	530 50	ms	56F05
Pu^{241}	th	a	1450 250	ms	56F05
	th	f	1060 210		56F05
Pu^{242}	pile	n,γ	30 10	ms	56F05
Pu^{243}	pile	n,γ	170 90	ms	56F05
Pu^{244}	pile	n,γ	1.5 3	$10^{h}Pu$	56F05
	pile	n,γ	2.1 4	$2.0^{h}Am$	56B32
	pile	n,γ	1.4	$2.0^{h}Am$	55F37
Pu^{245}	pile	n,γ	260 145	$25^{m}Am$	56F05
Cm^{245}	th	f	1800 300		56F11
E^{253}	pile	n,γ	450	$3.2^{h}Fm$	56J09

53D41 B.C.Diven, LA-1336 (1953); compared with neutron-proton scattering cross sections.

55B101 R.E.Bedford, A.M.Crooker, Can. J. Phys. 33, 25, 492 Errata (1955); Proc. Roy. Soc. Canada 48, 27A (1954); from Hg^{198} and Hg^{199} atomic spectra. Corrected value previously given (see N.S.A. 9, 24B reference 54B99 -Au^{198} heading was accidentally omitted) for finite irradiation time and Hg^{199} burnout.

55B142 R.E.Bell, R.L.Graham, L.Yaffe, Can. J. Phys. 33, 457; Phys. Rev. 99, 1646A (1955); based on $\sigma_a(Au^{197}) = 99$; same data as N.S.A. 9, 24B reference 55G29, Au^{198} heading was accidentally omitted.

55F37 P.R.Fields, M.H.Studier, A.M.Friedman, H.Diamond, R.Sjoblom, P.A.Sellers, J. Inorg. Nuclear Chem. 1, 262 (1955). (Correction to N.S.A. 10, 12B.)

56A16 M.Asdente, A.Bissi, E.Germagnoli, L.Zappa, Nuclear Phys. 1, 420 (1956); based on $\sigma_a(Sr^{88}) = 0.005 \pm 1$ and observed $\sigma_a(Sr^{84})/\sigma_a(Sr^{88}) = 318 \pm 21$.

56B35 R.M.Brugger, J.E.Evans, E.G.Joki, R.S. Shankland, Bull. Am. Phys. Soc. 1, No. 4, 176 F11 (1956).

56B40 L.E.Beghian, D.Hicks, B.Milman, Phil. Mag. 1, 261 (1956).

56B49 J.R.Beyster, M.Walt, Bull. Am. Phys. Soc. 1, No. 4, 176 P9 (1956).

56B50 N.G.Blosser, T.R.Handley, C.D.Goodman, Bull. Am. Phys. Soc. 1, No. 4, 224 W6 (1956); verbal report; Phys. Rev. 100, 429 (1955); based on $\sigma_{n,p}(Fe^{56}) = 0.110$.

56B62 R.L.Becker, H.H.Barshall, Phys. Rev. 102, 1384 (1956).

56B79 T.W.Bonner, J.H.Slattery, Bull. Am. Phys. Soc. 1, No. 4, 175 F7 (1956).

56C30 M.F.Crouch, V.E.Krohn, G.R.Ringo, Phys. Rev. 102, 1321 (1956); using σ_a coh = $4\pi a^2$.

56F05 P.R.Fields, G.L.Pyle, M.G.Inghram, H.Diamond, M.H.Studier, W.M.Manning, Nuclear Sci. Eng. 1, 62 (1956); Geneva Conf. 8/P/809; based on effective $\sigma_a(Pu^{239}) = 1150$ and $\sigma_{n,\gamma}(Pu^{239}) = 385$; σ's for Pu^{244} and Pu^{245} based on $\sigma_a(Au^{197}) = 98$.

56F11 P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H. Higgins, G.T.Seaborg, Phys. Rev. 102, 180 (1956).

56G15 J.B.Guernsey, A.Wattenberg, Phys. Rev. 101, 1516 (1956).

56G32 J.H.Gibbons, Phys. Rev. 102, 1574 (1956).

56H14 J.Halperin, R.W.Stoughton, C.V.Ellison, D.E. Ferguson, Nuclear Sci. Eng. 1, 1 (1956); based on $\sigma_a(Th^{232}) = 8.0$.

56H31 J.Halperin, R.W.Stoughton, C.M.Stevens, D.E. Ferguson, D.C.Overholt, Nuclear Sci. Eng. 1, 108 (1956); Geneva Conf. 8/P/732; based on $\sigma_{n,\gamma}(U^{238}) = 3.5$ and $\sigma_{n,\gamma}(U^{239}) = 50$. Studier, et al. in ANL 4667 (1951) report $\sigma_{n,\gamma}(U^{239}) = 22$, but Halperin et al. have increased this to take into account the large resonance absorption in U^{238}.

56H37 E.K.Hulet, H.R.Bowman, M.C.Michael, R.W.Hoff, Phys. Rev. 102, 1621 (1956); based on $\sigma_f(Pu^{239}) = 750$.

56H42 J.Haugsnes, Bull. Am. Phys. Soc. 1, No. 4, 187 K2 (1956).

56I01 G.Igo, H.H.Landon, Phys. Rev. 101, 726 (1956).

56J09 M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood, H.G.Jackson, Phys. Rev. 102, 203 (1956).

56K16 H.W.Kirby, G.R.Grove, D.L.Timma, Phys. Rev. 102, 1140 (1956); from 1952 value of Pomerance ($\sigma_a = 500$) corrected for more accurate weight of sample and for $\sigma_a(Au^{197}) = 98$ instead of 95.

56L06 W.S.Lyon, N.H.Lazar, Phys. Rev. 101, 1524 (1956); based on $\sigma_a(Mn^{55}) = 13.4$.

56M06 J.B.Marion, R.M.Brugger, R.A.Chapman, Phys. Rev. 101, 247 (1956).

56M40 R.L.Macklin, H.W.Schmitt, J.H.Gibbons, ORNL-2022 (1956).

56P10 N.J.Pattenden, J. Nuclear Energy 2, 187, 300 Errata (1956); Geneva Conf. 8/P/422. The value reported at Geneva and in the paper is 1050 ± 30. The errata note corrects this to 1015 ± 30.

56P15 R.R.Palmer, L.M.Bollinger, Phys. Rev. 102, 228 (1956).

56P25 B.C.Purkayastha, G.R.Martin, Can. J. Chem. 34, 293 (1956); based on $\sigma_a(Cu^{63}) = 4.24$.

56R29 L.Rosen, A.H.Armstrong, Bull. Am. Phys. Soc. 1, No. 4, 224 W7 (1956).

56S25 R.R.Smith, N.P.Alley, R.H.Lewis, A.VanderDoes, Phys. Rev. 101, 1053 (1956); based on $\sigma_a(Co^{59}) = 37.0$.

56V11 R.G.P.Voss, R.Wilson, Proc. Roy. Soc. 236A, 41 (1956). Diameter of liquid scintillator and absorber >> diameter of beam; used σ_t(C) of Taylor and Wood, Phil. Mag. 44, 95 (1953) to determine energy of neutron beam.

TABLE 3—GROUND STATE Q'S

Q values are defined by the conservation equation, $M_1 + M_2 = M_3 + M_4 + Q$ or $Q = E_3 + E_4 - E_1 + E_2$ where the M's are the rest masses and the E's the kinetic energies of the reacting particles. Ground state Q's are those measured when the product particles are left in their lowest energy states. If the most energetic emitted particles has escaped detection, the true ground state Q is greater than the value given.

The energy standard used, when clearly stated by the experimenter, is mentioned with the reference. Usually the energy measurement for only one particle, either the incident or emitted light particle, presents difficulties. It is the standard used for this particle that is given.

N. B. A uniform policy for denoting the use of enriched or monoisotopic material is now in use in all four New Nuclear Data Tables. This policy is described in the section on Conventions just following the Introduction. Briefly, parentheses around the A value indicate natural material, no parentheses enriched or monoisotopic material.

Reaction	Value		Source / Detector		Ref.
$Li^7(Li^7, p)B^{13}$	5.97	3	VdG	scin a	56A14
$B^{(10)}(d, t)B^{(9)}$	−2.187	10	VdG	s	56B52
$N^{(14)}(\alpha, n)F^{(17)}$	−4.76	7	cyc	66°F	56D47
$O^{18}(p, n)F^{18}$	−2.447	10	VdG	BF_3	56M18
$F^{19}(\alpha, n)Na^{22}$	−2.052	6	VdG	thresh	56B51
$Na^{23}(\alpha, n)Al^{26}$	−2.970	6	VdG	thresh	56B51
$Na^{23}(\alpha, n)Al^{26}$	−2.9	2	cyc	p recoil	56D47
$Al^{27}(d, p)Al^{28}$	5.502	10	VdG	s	56B13
$Al^{27}(\alpha, n)P^{30}$	−2.968	6	VdG	thresh	56B51
$A^{36}(\alpha, p)K^{39}$	−1.28	3	cyc	ppl	56S20
$A^{40}(\alpha, p)K^{43}$	−3.36	3	cyc	ppl	56S20
$K^{(39)}(n, \alpha)Cl^{(36)}$	1.25	20	VdG	scin	56S57
$Zr^{(90)}(\gamma, n)Zr^{(89)}$	−11.78	9	βtron	4°Zr	56M08

56A08 P. Axel, J. D. Fox, Phys. Rev. 102, 400 (1956); based on $Q[Cu^{63}(\gamma, n)] = 10.73\ 5$ and $Q[O^{16}(\gamma, n)] = 15.605\ 12$.

56A14 S. K. Allison, P. G. Murphy, E. Norbeck, Jr., Phys. Rev. 102, 1182 (1956); based on $Q[B^{10}(d, p_1)] = 7.097\ 9$.

56B13 W. W. Buechner, M. Marzari, A. Sperduto, Phys. Rev. 101, 188 (1956); based on H_ρ(Po α) = 331,590.

56B51 B. S. Burton, R. M. Williamson, Bull. Am. Phys. Soc. 1, No. 5, 264 F3 (1956); verbal report; based on $Li^7(p, n)$ threshold = 1.8811 5.

56B52 C. K. Bockelman, A. Lévêque, W. W. Buechner, Bull. Am. Phys. Soc. 1, No. 6, 280 B1 (1956).

56D47 W. T. Doyle, A. B. Robins, Phys. Rev. 101, 1056 (1956); 98, 1185A (1955).

56M18 H. Mark, C. Goodman, Phys. Rev. 101, 768 (1956); based on $Li^7(p, n)$ threshold = 1.8814 11.

56S20 P. B. Schwartz, J. W. Corbett, W. W. Watson, Phys. Rev. 101, 1370 (1956); 99, 655A (1955); based on $Q[N^{14}(\alpha, p)] = -1.198$ from masses.

56S57 M. J. Scott, R. E. Segel, Phys. Rev. 102, 1557 (1956).

TABLE 4—MASS DIFFERENCES AND RATIOS

Where no superscripts have been used with H, C, and O, the weights of the most abundant isotopes, namely 1, 12 and 16 respectively, are to be understood. Differences are given in millimass units.

	Value		Ref.
$B^{10}H - B^{11}$	+11.450	12	56L27
$B^{10}B^{11}H_2 - Na^{23}$	+48.130	10	56L27
$B^{11}H - C$	+17.139	7	56L27
$Na^{23} - B^{10}B^{11}H_2$	−48.130	10	56L27
$k^{39} - C_3H_3$	−59.762	20	56L27
$K^{41} - C_3H_5$	−77.331	20	56L27
$Ni^{58} - C_3H_6O$	−106.52	15	56E10
$Ni^{60} - C_2H_4O_2$	−90.82	15	56E10

56E10 P. C. Eastman, N. S. [illegible], G. R. Bainbridge, H. E. Duckworth, Phys. Rev. 103, 145 (1956).

56L27 H. Liebl, H. Ewald, Z. Naturf. 11a, 406 (1956).